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Dentistry Section

Periodontal Disease and Its Impact on Migraine-specific Quality of Life: A Cross-sectional Study using MSQ v2.1 Questionnaire

SARVESH GANAPATHY[1], DEEPA PONNAIYAN[2], CM ANITHA[3], DHAYANAND JOHN VICTOR[4]

ABSTRACT

Introduction: Migraine is a prevalent and disabling neurovascular disorder that significantly impairs Quality of Life (QoL). Identifying modifiable systemic factors that influence migraine burden is essential for improving patient outcomes. Periodontal Disease (PD), a chronic inflammatory condition, contributes to systemic inflammation through persistent immune activation and elevated pro-inflammatory mediators, which are also implicated in migraine pathophysiology. However, the impact of PD on migraine-specific QoL has not been adequately investigated.

Aim: To evaluate the impact of PD on migraine-specific QoL using the Migraine-specific QoL Questionnaire version 2.1 (MSQ v2.1).

Materials and Methods: A cross-sectional study was conducted at the Outpatient Department of Periodontics, SRM Dental College, in collaboration with SRM General Hospital, Chennai, Tamil Nadu, India, from January 2025 to June 2025. A total of 110 migraine patients aged 18-65 years were enrolled. Group I (n=55) consisted of periodontally healthy individuals with migraine, while Group II (n=55) consisted of individuals with PD and migraine. Migraine was diagnosed according to the International Classification of Headache Disorders, 3rd edition (ICHD-3), and periodontal status was classified using the 2017 World Workshop Classification. Participants with systemic conditions affecting periodontal or neurological health or those unable to complete the questionnaire were excluded. Periodontal parameters {Probing Pocket Depth (PPD), Clinical Attachment Loss (CAL) and Plaque Indices (PI)] were recorded, and migraine-specific QoL was assessed using the MSQv2.1 across the Role Function Restrictive (RFR), Role Function Preventive (RFP), and Emotional Function (EF) domains. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 26.0, with normality testing and appropriate parametric and categorical comparisons; $p<0.05$ was considered statistically significant.

Results: Significantly lower MSQ v2.1 domain scores were observed in all participants with PD compared to those without PD ($p<0.001$ for all). Notably, the PD group demonstrated a markedly reduced mean total MSQ v2.1 score (17.26±3.09), indicating severe impairment of migraine-specific QoL. These findings indicate a strong negative association between PD and the functional and emotional well-being of migraine patients.

Conclusion: The PD appears to negatively influence migraine-specific QoL. These findings underscore the importance of interdisciplinary management for individuals with co-existing PD and migraine. Further research is warranted to elucidate the underlying mechanisms and to explore potential therapeutic interventions.

Keywords: Chronic orofacial pain, Gingival inflammation, Headache disorders, Oral health assessment, Patient-reported outcomes

INTRODUCTION

Migraine is a common and disabling neurological disorder characterised by recurrent, severe headaches often accompanied by nausea, photophobia, phonophobia, and vomiting. It significantly impairs QoL, affecting physical, emotional, and social functioning [1,2]. Migraine typically progresses through four phases: prodrome (early symptoms such as irritability and fatigue), aura (visual or sensory disturbances), headache (intense, pulsating pain lasting 4-72 hours), and postdrome (fatigue and mood changes) [3,4]. Diagnosis is based on clinical criteria outlined in the International Classification of Headache Disorders (ICHD-3) and may involve imaging to rule out other causes [5]. Migraines involve complex neurological and vascular mechanisms, including cortical spreading depression and activation of the trigeminal nerve. Genetic susceptibility, environmental triggers, and co-morbidities such as anxiety and depression contribute to disease onset, severity and progression [6,7]. The disorder can severely disrupt daily functioning, including occupational performance and social activities [8].

The MSQv2.1 is a validated tool that assesses the impact of migraines on a patient's QoL across three domains: Role Function Restrictive (RFR), Role Function Preventive (RFP), and Emotional Function (EF) [9]. It employs a 6-point Likert scale, with lower scores indicating greater impairment. The MSQv2.1 is useful for monitoring treatment effectiveness, individualising care, and capturing patient-reported outcomes, thereby providing detailed insights into how migraines affect daily life. However, despite its sensitivity and comprehensiveness, limitations include potential self-report bias and a focus on migraine-specific QoL, which may overlook the influence of comorbid conditions [10].

Periodontal disease (PD), a chronic inflammatory condition affecting the gums and supporting tooth structures, has been associated with various systemic diseases, including cardiovascular and metabolic disorders. Recent research suggests a potential relationship between PD and migraine, with mechanisms such as systemic inflammation, bacterial dissemination, and neurovascular activation possibly contributing to both conditions [11]. Chronic inflammation resulting from PD may lead to the release of pro-inflammatory cytokines that affect the central nervous system, potentially exacerbating migraine-related QoL impairment [12]. Despite these emerging links, the impact of PD on migraine-specific QoL remains

unclear and underexplored. Hence, the study aimed to evaluate the effect of PD on MSQ v2.1 among individuals with migraine. By comparing MSQ v2.1 scores between migraine patients with clinically confirmed PD and those without periodontal involvement, the study seeks to determine whether periodontal inflammation contributes to an additional QoL burden in migraine.

The null hypothesis stated that MSQ v2.1 scores do not differ between individuals with and without PD.

The alternative hypothesis is that the presence of PD is associated with significantly poorer migraine-related QoL, as reflected by lower MSQ v2.1 scores.

Examining these hypotheses aims to clarify whether periodontal inflammatory status influences migraine outcomes, thereby supporting the development of integrative management strategies that address both oral health and neurological well-being in patients with migraine.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Outpatient Department of Periodontics, SRM Dental College, in collaboration with SRM General Hospital, Ramapuram, Chennai, Tamil Nadu, India, from January 2025 to June 2025. Ethical approval was obtained from the Institutional Review Board (IRB) to ensure that the study complied with ethical standards, SRMDC-IRB(SRMU/M&HS/SRMDC/2024/PG/016). Written informed consent was collected from all participants before enrollment, ensuring they understood the study's purpose, procedures, potential risks, and benefits.

Inclusion criteria: Participants included adults aged 18-65 who were diagnosed with chronic migraines and either had or did not have PD. Individuals who self-reported experiencing migraines at least once a month for the past six months and consented to participating in the study were included.

Exclusion criteria: Participants with systemic diseases known to affect both periodontal health and migraine frequency (e.g., uncontrolled diabetes, systemic inflammatory diseases) and those unable to complete the MSQ v2.1 questionnaire were excluded from the study.

Sample size: Consequently, 110 participants were enrolled in the study, ensuring that the final sample (n=110) met all inclusion and exclusion criteria for assessing the impact of PD on migraine-specific QoL. Using reported effect sizes and standard deviations, a power analysis with an alpha of 0.05 and 80% power indicated that a minimum of 110 participants was required to detect significant differences in MSQv2.1 scores between participants with and without PD. Previous meta-analyses evaluating oral health-related QoL in individuals with periodontitis have demonstrated moderate to large effect sizes. Reported estimates include a Standardised Mean Difference (SMD) of approximately 0.75 (95% CI: 0.53–0.93) and a mean difference of about 5.14 points on the OHIP-14 scale. Additionally, a weighted mean difference of approximately 6.11 points (95% CI: 4.23-7.99) in total OHIP-14 scores has been observed between periodontitis and control groups. These published effect size estimates and associated standard deviations were used to inform the sample size calculation [13].

A total of 130 individuals were initially screened for eligibility. Of these, 10 declined to participate, and 10 were excluded due to systemic diseases, recent periodontal treatment, or other exclusion criteria. These participants were then divided into two groups based on their periodontal status:

- Group I (n=55) consisted of individuals with a periodontally healthy status and migraine, while
- Group II (n=55) consisted of individuals with PD and migraine.

This classification enabled a direct comparison of migraine-specific QoL between individuals with and without PD.

Based on an estimated effect size, the sample size was calculated to include 110 participants (α=0.05), ensuring sufficient power to detect significant differences. Participants were recruited through clinical settings (e.g., local dental and headache clinics), online surveys, and referrals from healthcare providers. Demographic information collected included age, gender, occupation, and the severity of PD, which was classified as mild, moderate, or severe based on clinical examination.

Occupation was classified using a standardised categorisation adapted from the Modified Kuppuswamy Socioeconomic Status Scale [14]. Occupational status was assessed as part of the baseline demographic data and categorised into professional, self-employed, salaried, skilled, homemaker, and student, based on the participant's primary occupation. This classification was adopted to evaluate potential socioeconomic differences between the study groups and for descriptive comparison [15].

Study Procedure

Clinical assessment of periodontal parameters: The PD was assessed using a combination of clinical parameters. The diagnostic criteria included plaque indices [16], Probing Pocket Depth (PPD) [17], and Clinical Attachment Loss (CAL), which were indicative of PD. The assessment involved measuring probing depth using a periodontal probe, where depths greater than 3 mm were considered abnormal, and CAL, where a CAL greater than 3 mm indicated attachment loss [18]. PD was assessed using the staging and grading system from the American Academy of Periodontology and included patients ranging from Stage II to IV periodontitis. Stage II (Moderate) includes probing depths of 4-6 mm and moderate attachment loss; Stage III (Severe) is marked by probing depths > 6 mm, significant attachment loss, and possible tooth mobility; Stage IV (Advanced) includes severe destruction and extensive tooth loss [19].

Evaluation of Migraine-specific Quality of Life (QoL) (MSQ v2.1): The Migraine-specific QoL Questionnaire version 2.1-English version (MSQ v2.1-E) is a 14-item, validated instrument designed to measure the impact of migraines on QoL across three domains: role functioning, and EF. The MSQv2.1 was developed by GlaxoSmithKline Research and Development Limited (GSK), and its copyright is held by Glaxo Wellcome Inc. (©1992, 1996, 1998) by MapiResearch. Proper approval from Mapi trust was obtained before using MSQ v2.1 as a tool for this study. This questionnaire is used with permission under MAPI Research Trust publication approval [20].

The questionnaire has demonstrated strong internal consistency reliability, with reported Cronbach's alpha values typically ranging from 0.80 to 0.95 across different populations and language versions. Specifically, alpha values are commonly around 0.90-0.96 for RFR, 0.86-0.91 for RFP and 0.80-0.90 for EF, indicating excellent reliability and stable measurement properties for both clinical and research applications [21]. RFR, originally called RFR in MSQv2.1, consists of seven items assessing how migraine limits the ability to perform normal activities; RP, originally named RFP, which has four items focusing on how migraines interrupt normal activities; and EF, comprising three items that measure the emotional impact of migraines, such as feelings of frustration or helplessness. Respondents rate each item on a scale from 1 to 6 (1="None of the time," 2="A little bit of the time," 3="Some of the time," 4="A good bit of the time," 5="Most of the time," and 6="All of the time"). All responses are reverse-coded and standardised to a 0–100 scale. Consequently, higher scores reflect a better QoL with migraines. The domain scores are combined to generate an overall score, with lower scores reflecting a greater negative impact on QoL [22-24]. For example, a participant with high role functioning and vitality scores but low EF scores may indicate that migraines severely affect their emotional well-being but less so their daily

activities. The MSQ v2.1 was self-administered in the form of paper during the visit. Participants complete the questionnaire based on their experiences over the previous week or month. For categorical analysis, the total MSQ v2.1 score, standardised to a 0-100 scale, was further classified into levels of migraine-related QoL impairment using predefined cut-off values. Since higher MSQ v2.1 scores indicate better QoL and lower scores reflect greater impairment, participants were categorised as having mild impairment (total MSQ score ≥75), moderate impairment (total MSQ score 50-74), or severe impairment (total MSQ score <50). This categorisation was used to facilitate descriptive comparison and Chi-square analysis of migraine-specific QoL distribution between the study groups [21].

All periodontal assessments, including probing depth, CAL, and gingival bleeding, were performed by a single calibrated examiner. To ensure consistency, the examiner re-evaluated a subset of 20 participants after one week. Continuous variables (probing depth and CAL) showed excellent agreement with an Intraclass Correlation Coefficient (ICC) of 0.89, while categorical variables (presence or absence of gingival bleeding) demonstrated substantial agreement with a Cohen's Kappa (κ) value of 0.81. This calibration ensured reliable and reproducible periodontal measurements throughout the study.

STATISTICAL ANALYSIS

Normality was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests, confirming that all variables followed a normal distribution. Parametric methods were applied for analysis. An independent samples t-test was used to compare mean values between groups, while proportions between study and control groups were analysed using the Chi-square test. Fisher's exact test was applied if any expected cell frequency was <5. Data analysis was conducted using IBM SPSS Statistics (Version 26.0, IBM Corp., 2019), with the significance level set at $p<0.05$.

RESULTS

In the present study, a total of 110 participants were recruited, with 55 in each group. The average age of participants in group I was 32.96 years, and in group II was 32.13 years, respectively. The periodontal parameters, such as PPD, CAL, and PI, were highly significant between the groups ($p <0.001$). Similarly, the MSQ domain scores and the total MSQ score were significantly different between the groups ($p<0.001$) [Table/Fig-1]. In the present study, the migraine-specific QoL as interpreted by the MSQ scores showed high significance between the groups ($p<0.001$). Categorical comparison using the Chi-square test revealed no statistically significant difference in occupational distribution between group I and group II ($\chi^2=0.228$, $p=0.999$), suggesting that the groups were comparable with respect to occupation and minimising the likelihood of occupational confounding in the assessment of migraine-specific QoL. In group II, 54 participants (98.2%) were classified as having severe migraine-specific QoL impairment, as shown in [Table/Fig-2]. Domain 1 of MSQ v2.1 i.e., RFR, was the most affected in participants of group II (17.41±3.71) followed by Domain 2 i.e., RP (18.1±4.54), and Domain 3 i.e., EF (18.2±3.9) [Table/Fig-3].

DISCUSSION

The relationship between PD and migraine-specific QoL, as assessed using the MSQ v2.1, highlights an intriguing intersection of oral and neurological health. Both conditions are associated with chronic inflammation, systemic effects, and significant impacts on daily functioning. PD, characterised by progressive tissue destruction due to bacterial infection and immune dysregulation, may exacerbate systemic inflammatory responses [25,26]. These responses can influence migraine pathophysiology through shared mechanisms, such as elevated levels of pro-inflammatory cytokines (e.g., IL-1β, IL-6, and TNF-α), which have been linked to migraine severity and frequency [27]. The chronic nature of these conditions and their mutual exacerbation through systemic pathways may have profound implications for patients' physical, emotional, and functional well-being, core components assessed by the MSQ v2.1 [15]. The present study demonstrated statistically significant differences in all MSQ v2.1 domain scores and total scores between migraine patients with and without PD ($p<0.001$). In light of these findings, the null hypothesis, which proposed that there would be no difference in migraine-specific QoL between individuals with and without PD, is rejected. The results support the alternative hypothesis that the presence of PD is significantly associated with poorer migraine-specific QoL.

In the present study, participants with both migraine and periodontitis demonstrated markedly reduced MSQ v2.1 domain and total scores, indicating a high level of impairment in migraine-specific QoL. Further, it was seen that 98.2% of subjects who had periodontitis and migraine had a severe impairment of QoL. This finding is similar to Tsimpiris A et al., who observed a significant association of migraine with clinical periodontal parameters. However, there were no studies correlating MSQ with periodontal health [28].

The MSQ v2.1 assesses the impact of migraine on daily functioning and emotional well-being, with domains focusing on RFR, RFP, and EF. While the MSQ v2.1 does not explicitly categorise respondents by profession, its domains implicitly capture aspects of occupational impact. For instance, the RFR domain evaluates how migraine affects the ability to perform normal activities, which can include work-related tasks. Studies have shown that migraine significantly impairs QoL across various countries, affecting work and activity levels. Additionally, research indicates that individuals with chronic migraine experience greater functional impairment compared to those with episodic migraine, as measured by the MSQ. Therefore, while the MSQ v2.1 does not directly assess profession, its domains are relevant for evaluating the occupational impact of migraine [10,15,26].

Given that migraines often result in significant disability, affecting work productivity, social interactions, and mental health, any condition that potentially exacerbates their severity, such as PD, warrants scrutiny [29,30]. By investigating how periodontal health influences MSQv2.1 outcomes, researchers could better understand the interplay between oral and neurological health. Such studies could inform interdisciplinary treatment strategies, where improving periodontal health might reduce systemic inflammation and, consequently, improve migraine-specific QoL. This integrated approach could lead to novel therapeutic pathways, enhancing patient care across dental and neurological disciplines.

Previous literature has highlighted the inflammatory pathways common to both PD and migraines. PD is characterised by persistent

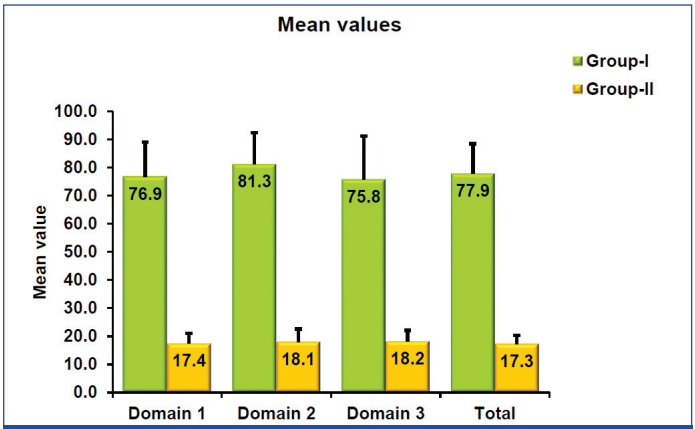
Parameters	Group I (Periodontally healthy with migraine) (Mean±SD)	Group II (Periodontal disease with migraine) (Mean±SD)	n	t-value	p-value
Age (in years)	32.96±8.628	32.13±7.105	55	0.551	0.580
PPD	2.616±0.8364	5.418±0.9611	55	-16.31	<0.001**
CAL	0.000±0.000	4.713±0.9214	55	-37.93	<0.001**
MSQ Domain 1	76.86±12.20	17.39±3.71	55	34.59	<0.001**
MSQ Domain 2	81.31±11.15	18.06±4.54	55	38.96	<0.001**
MSQ Domain 3	75.84±15.36	18.24±3.9	55	26.96	<0.001**

Total MSQ score	77.93±10.59	17.26±3.09	55	40.79	<0.001**
PI	1.218±0.686	3.000±0.000	55	-19.26	<0.001**

[Table/Fig-1]: Comparison of clinical parameters and MSQ domains between groups.
Independent samples t-test was used. *SD: Standard deviation; *PPD:Probing Pocket; Depth, CAL: Clinical Attachment Loss, PI : Plaque indices*; MSQ: Migraine-specific quality of life; *p-value<0.05 is significant **highly significant

Variables	Group I (Periodontally healthy with migraine) n (%)	Group II (Periodontal disease with migraine) n (%)	Total n (%)	χ^2	p-value
Gender					
Male	30 (54.5)	25 (45.5)	55 (50.0)	0.90	0.340
Female	25 (45.5)	30 (54.5)	55 (50.0)		
Age group (years)					
20-24	12 (21.8)	8 (14.5)	20 (18.2)	9.17	0.041*
25-29	10 (18.2)	17 (30.9)	27 (24.5)		
30-34	11 (20.0)	7 (12.7)	18 (16.4)		
35-39	8 (14.5)	17 (30.9)	25 (22.7)		
≥40	14 (25.5)	6 (10.9)	20 (18.2)		
Occupation					
Professional	20 (36.4)	19 (34.5)	39 (35.5)	0.228	0.999
Self-employed	7 (12.7)	6 (10.9)	13 (11.8)		
Salaried	14 (25.5)	15 (27.3)	29 (26.4)		
Skilled	5 (9.1)	6 (10.9)	11 (10.0)		
Homemaker	2 (3.6)	2 (3.6)	4 (3.6)		
Student	7 (12.7)	7 (12.7)	14 (12.7)		
QoL					
Mild	39 (70.9)	0	39 (35.5)	106.24	<0.001*
Moderate	16 (29.1)	1 (1.8)	17 (15.5)		
Severe	0	54 (98.2)	54 (49.0)		

[Table/Fig-2]: Comparison of descriptive parameters and migraine-specific Quality of Life (QoL) in Groups I and II.
Migraine-specific Quality of Life (QoL) was categorised into mild, moderate, and severe impairment based on predefined total MSQv2.1 score cut-offs. Chi-square test was used for categorical comparisons, and p-value <0.05 considered statistically significant.



[Table/Fig-3]: Depicts the mean values of the MSQ v2.1 domain and total scores in Group I (periodontally healthy with migraineurs) and Group II (Periodontal Disease (PD) with migraine).
*Domain 1- Role Function Restrictive (RFR), Domain 2-Role Function Preventive (RFP), Domain 3 -Emotional Function (EF).

local inflammation resulting from bacterial biofilm accumulation, which stimulates the release of pro-inflammatory cytokines such as IL-1β, IL-6, and TNF-α, as well as other mediators like prostaglandins. These inflammatory molecules can disseminate into the systemic circulation, increasing overall inflammatory burden and potentially affecting distant organs, including the central nervous system. Systemic inflammation can sensitise the trigeminovascular system, promoting the release of neuropeptides such as Calcitonin Gene-related Peptide (CGRP), leading to vasodilation, plasma extravasation, and activation of nociceptive pathways implicated in migraine pain [31,32]. Additionally, chronic inflammatory signalling may contribute to endothelial dysfunction and oxidative stress, both of which can exacerbate cortical hyperexcitability and lower the threshold for migraine attacks. Persistent peripheral inflammation also facilitates central sensitisation within the trigeminal nucleus caudalis and higher pain-processing centres, amplifying pain perception and attack frequency. The convergence of these mechanisms highlights a shared inflammatory axis between PD and migraine, providing a biological rationale for the observed impairments in physical, emotional, and functional domains of migraine-specific QoL as measured by the MSQ v2.1 [25,33]. This study's incorporation of the MSQ v2.1 allows for a comprehensive evaluation of the QoL specific to migraine sufferers, capturing essential dimensions such as functional impairment and emotional well-being. By examining the association between PD indicators and MSQ v2.1 scores, we can explore how oral health may directly or indirectly influence migraine severity, frequency, and overall impact on patients' QoL.

Moreover, the findings from this questionnaire-based study could underscore the importance of holistic treatment approaches in managing migraines. If a significant link is established between periodontal health and QoL in migraineurs, healthcare providers may need to consider dental assessments and interventions as an integral part of migraine management. This could lead to improved patient outcomes and greater awareness of the systemic impacts of oral health. Future research directions could explore the mechanisms underlying these relationships, such as inflammatory mediators or shared risk factors, as well as the potential for interventional studies to assess the effectiveness of periodontal treatment in improving migraine-related QoL.

Overall, the present study contributes to the growing body of evidence that highlights the interconnectedness of systemic health conditions, advocating for a comprehensive approach to patient care that addresses both oral and neurological domains. Future research should consider well-designed interventional studies to determine whether periodontal therapy can lead to quantifiable improvements in migraine-specific QoL. Longitudinal investigations are warranted to elucidate potential causal relationships between periodontal status and migraine outcomes, and mechanistic studies could explore the inflammatory and neurovascular pathways linking PD to migraine pathophysiology. Such work may inform integrated clinical strategies targeting both oral health and migraine management.

Limitation(s)

The present study has certain limitations. Being cross-sectional in nature, it allows identification of associations between PD and migraine-specific QoL but does not permit inference of causality or temporal relationships, nor does it allow estimation of disease incidence. Additionally, the single-centre setting may limit the generalisability of the findings to broader populations. Future longitudinal, multi-centre studies with larger cohorts are warranted to confirm these associations and explore potential causal relationships. In addition, potential confounding factors such as

stress, sleep quality, smoking, or medication use were not fully controlled, which may have influenced the results.

CONCLUSION(S)

The present study demonstrated a significant association between PD and migraine-specific QoL, as measured by the MSQ v2.1. These results emphasise the importance of incorporating periodontal assessment and care into the holistic management of individuals with migraines. By improving periodontal health, it may be possible to reduce systemic inflammation, alleviate migraine burden, and enhance overall QoL. The observed association underscores the need for integrated dental and neurological care and highlights the importance of longitudinal studies to investigate causality and evaluate the potential benefits of targeted periodontal interventions.

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Authors' contribution: SG: Recruited patients, collected data, and drafted the initial manuscript: DP: Led conceptualisation and methodology; SG and DP: Performed statistical analysis and interpreted the data; DP and CMA: Supervised the study and provided critical revisions. All authors read and approved the final manuscript.

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PARTICULARS OF CONTRIBUTORS:
1. House Surgeon (CRRI), SRM Dental College, Ramapuram, Chennai, Tamil Nadu, India.
2. Professor, Department of Periodontics, SRM Dental College, Ramapuram, Chennai, Tamil Nadu, India.
3. Senior Lecturer, Department of Periodontics, SRM Dental College, Ramapuram, Chennai, Tamil Nadu, India.
4. Professor and Head, Department of Periodontics, SRM Dental College, Ramapuram, Chennai, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Deepa Ponnaiyan,
Professor, Department of Periodontics, SRM Dental College, Bharathi Salai, Ramapuram, Chennai-600089, Tamil Nadu, India.
E-mail: deepa_ponnaiyan@yahoo.co.in

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