J Oral Res
research in oral sciences

ARTICLE

COMPARISON OF GINGIVAL INFLAMMATORY PARAMETERS AND PAIN PERCEPTION ON PERIODONTAL PROBING - A CROSS SECTIONAL STUDY, PART II.

Comparación de parámetros inflamatorios gingivales y percepción del dolor en el sondaje periodontal- Un estudio transversal, Parte II.

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CITE AS:
Ashwath B, Shanmugam M, Agila E, Anitha V, Aishwarya D & Zafrin A. Comparison of Gingival Inflammatory Parameters and Pain Perception on Periodontal Probing - A cross sectional study, Part II.
J Oral Res.2022;11(5):1-11.
doi:10.17126/joralres.2022.053

ABSTRACT:

Background: Probing of the periodontal pocket is an essential part of the diagnosis of periodontal disease and 15-77% of untreated periodontal patients experience pain during probing. Therefore, the objective of this study is to evaluate the pain perceived by patients with dental plaque-induced gingivitis and chronic periodontitis during periodontal probing and the main objective includes the evaluation of the relationship between pain perceived during periodontal probing and gingival inflammatory parameters.

Material and Methods: A total of 475 participants were recruited into the study. The patients were divided into two groups: Group-A (Gingivitis Group - 275 patients) and Group-B (Chronic Periodontitis Group - 200 patients). Clinical parameters included analysis of bleeding on probing, simplified gingival index, pocket depth on probing, and clinical attachment level. Pain score was recorded using the HP VAS scale and all patients participated in the study after a detailed explanation of the study protocol.

Results: A significant difference in pain perception was noted between groups, highlighting the role of the degree of inflammation in the examination of periodontal parameters.

Conclusion: Within the limitations of the present study, we can conclude that pain perception is directly correlated with the degree of inflammation in periodontitis rather than plaque-induced gingivitis during periodontal probing. Therefore, some form of adjuvant topical anesthesia may be considered in order to reduce pain levels in severely inflamed patients, to encourage continued acceptance of supportive periodontal therapy.

KEYWORDS:

Chronic Periodontitis; gingivitis; pain perception; periodontal index; inflammation; gingiva.

Received: September 30, 2021 | **Accepted:** January 26, 2022 | **Published online:** June 30, 2022.

RESUMEN:

Antecedentes: El sondaje de la bolsa periodontal es una parte esencial en el diagnóstico de la enfermedad periodontal. 15-77% de los pacientes periodontales no tratados experimentan dolor durante el sondaje. Por lo tanto, el objetivo de este estudio es evaluar el dolor percibido por pacientes con gingivitis inducida por placa dental y periodontitis crónica durante el sondaje periodontal y el objetivo principal incluye la evaluación de la relación entre el dolor percibido durante el sondaje periodontal con parámetros inflamatorios gingivales.

Material y Métodos: Un total de 475 sujetos fueron reclutados en el estudio. Los sujetos se dividieron en 2 grupos: Grupo - A (Grupo de gingivitis - 275 pacientes) y Grupo - B (Grupo de periodontitis crónica - 200 pacientes). Los parámetros clínicos incluyeron el análisis del sangrado al sondaje, el índice gingival simplificado, la profundidad de la bolsa al sondaje y el nivel de inserción clínica. La puntuación del dolor se registró utilizando la escala HP VAS y todos los pacientes participaron en el estudio después de una explicación detallada del protocolo del estudio.

Resultados: Se notó una diferencia significativa en la percepción del dolor en el grupo B que en el grupo A, lo que significa el papel del grado de inflamación en el examen de los parámetros periodontales.

Conclusión: Dentro de las limitaciones del presente estudio, podemos concluir que la percepción del dolor se correlaciona directamente con el grado de inflamación que se observa en la periodontitis más que con la gingivitis inducida por la placa dental durante el sondaje periodontal. Por lo tanto, se puede considerar alguna forma de anestesia tópica adyuvante para reducir los niveles de dolor en pacientes gravemente inflamados para fomentar la aceptación continua de la terapia periodontal de apoyo.

PALABRAS CLAVE:

Periodontitis crónica; gingivitis; percepción del dolor; índice periodontal; inflamación; encía.

INTRODUCTION.

In most of the cases, some degree of underlying inflammation is present, to aid in the physiologic immune surveillance,[1,2] which is present even in healthy gingiva. According to the World Health Organization, health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity.

In accordance with this, health is a state free from inflammatory periodontal disease that allows the individual to function normally.[1]

Gingivitis is initiated when this balance between the host inflammatory response and biofilm is disrupted, most commonly by dental plaque. According to Murakami *et al*.,[2] the universal features of gingivitis are:

1). Clinical signs and symptoms of inflammation not extending beyond the mucogingival junction.

2). Reversibility of the condition, upon removing the biofilm.[3]

Stable attachment level. The patient is often unaware of the underlying disease activity, as these signs and symptoms are often subtle. In most of the cases, gingivitis is a prerequisite for periodontitis to manifest.[3] However, not every case of gingivitis progresses to periodontitis.

Periodontitis is defined as an inflammatory disease of the supporting tissues around the teeth, which can cause irreversible loss of periodontal ligament, alveolar bone, tooth mobility and ultimately, if left untreated, tooth exfoliation.[4] The disease progresses as increased inflammatory infiltrate in the supporting tissues causes progressive attachment loss, thus leading to periodontal pocket formation. The apical migration of the attached gingiva leads to loss of clinical attachment level (CAL).

Two important markers can be used in assessing the disease activity - gingival crevicular fluid and bleeding on probing.[5]

This study assesses bleeding on probing as a major etiological factor in periodontal tissue inflammation and also uses modification of Gingival Index for assessing the degree of inflammation/ disease followed by pain experienced by the patient during probing.

Bleeding on probing is a primary parameter which sets the threshold in a case of gingivitis.[1,6,7] This is the first marker in signifying the presence of active disease. Assessment of bleeding on probing can also serve as a motivating factor for the patients to improve their oral home care.

Sites which bleed on probing (using an acceptable constant force of 0.25N) signify an increased percentage of cell rich and collagen reduced connective tissue,[6] thus leading to vascular fragility. Ideal probing force should not induce trauma,[1] but only provoke bleeding in tissues rich in inflammatory infiltrate. When probing force is increased, it is more likely that it increases the pain experienced in healthy sites and even more in inflamed areas. According to the International Association for the Study of Pain, pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described by the patient in terms of such damage.

Pain is one of the common symptoms of any disease and periodontal pain continues to be a useful diagnostic tool to assess the disease severity and treatment outcome.[8] Fear of pain is the most common reason why patients avoid dental treatments.

Pain is not simply because of the intensity of stimulation of nociceptors.[9,10] Assessing and comparing the pain levels with different gingival and periodontal parameters, as mentioned previously, forms the basis of this study. Other parameters like gingival index - denoting the severity of gingivitis, probing depth and attachment loss - the past disease activity, are assessed to associate the pain experienced during probing.

Gingival index (Loe *et al.*,[13]) is useful in visual assessment and mechanical stimulation of marginal tissues by probing gently along the soft tissue wall of the gingival sulcus. The degree of inflammation around a particular tooth is assessed in four sites and graded accordingly. This is one of the simplest and most commonly used index to assess the severity of a case of gingivitis.

Furthermore, histological studies also show that higher percent of lymphocytes and lower percent of fibroblasts were associated with high gingival index scores.[11,12] Periodontal examination forms the baseline for preliminary examination for the oral cavity. Discomfort or pain associated with insertion of periodontal probe is a common clinical event.

Hence this study aims at assessing the pain experienced during periodontal probing in patients with dental plaque induced gingivitis and chronic periodontitis and primary objective includes evaluation of relationship between pain per-ceived during periodontal probing with gingival inflammatory parameters

MATERIALS AND METHODS.

Study population and selection

This prospective study was carried out on 468 patients who reported as outpatients to the Department of Periodontology, Chettinad Dental College and Research Institute, Kelambakkam, between April and September 2019 (Figure 1).

The study was approved by the institutional Human Ethical Committee, Chettinad Health City (IHEC No: 470). All subjects signed a written informed consent. The subjects were enrolled in the study after fulfilling the inclusion and exclusion criteria.

Exclusion criteria included: patients who had undergone previous periodontal therapy in the previous six months, patients currently undergoing orthodontic therapy, patients presenting with pulpitis, acute periodontal pain or any other acute infections.

Inclusion criteria included: systemically healthy

ISSN Print 0719-2460 - ISSN Online 0719-2479.

individuals, presence of a minimum of 24 fully erupted teeth including third molars.

Study Design

This study was planned as a randomized, single-blinded clinical study. The participants were divided into 2 groups:

Group-A (Gingivitis group consisting of 275 patients) and;

Group-B (Periodontitis group consisting of 200 patients) based on the Classification of Periodontal Diseases and Conditions – AAP 1999, (Figure 1).

A conventional UNC-15 (Hu-freidy, Germany) probe was used to record the clinical parameters.

Study methodology

The clinical examination and data recording was performed by a single trained examiner- a dental graduate intern posted in Department of Periodontology under the supervision of a senior faculty, in order to reduce inter-examiner variability.

For those patients who were taken up for the study, clinical examination of gingiva was performed to include pain perception at the probing site, two parameters of inflammation: a modification of gingival index Loe *et al.*,[13] and a bleeding on probing scores, assessment of periodontal probing depth and clinical attachment levels was performed.

Gingival index

The simplified version of the gingival index (Loe and Silness, 1964) was used for this study, taking into account the ease of examination and patient convenience. Four sites (mesiobuccal, midbuccal, distobuccal, lingual) were probed in the 6 index teeth (16, 22, 24, 36, 42, 44) sequentially.

The gingival index score, representing the state of gingival inflammation in each of the index teeth was recorded. The response obtained was graded as follows:

0: Normal gingiva;

1: Mild inflammation – slight change in colour and slight edema but no bleeding on probing;

2: Moderate inflammation – redness ,edema and glazing , bleeding on probing;

3: Severe inflammation – marked redness and edema, ulceration with tendency to spontaneous bleeding; The final gingival index value for each of the patients was calculated, which gives the overall gingival condition of the patient.

Bleeding on probing (BOP)

The gingival bleeding index (Ainamo and Bay, 1975) was performed in the study. The teeth present in each quadrant were probed sequentially and a positive finding was recorded when bleeding occurred within 10 seconds. The procedure was carried in a similar fashion in other quadrants. The gingival and gingival bleeding indices were recorded simultaneously while probing a particular tooth. The bleeding on probing score was documented for each quadrant as present or absent.

Recording of pain perception

In this study, Heft Parker Visual Analogue Scale (HP VAS) was used, for the patients to rate the amount of pain experienced. The HP VAS is divided into 8 categories - none (0mm), faint (26mm), weak (36mm), mild (54mm), moderate (85mm), strong (114mm) and intense (144mm)(Figure 2).[14]

A copy of the scale was provided to each patient at the time of probing. During the aforementioned examinations, patients were asked to rate the intensity of pain experienced, using the HP VAS. The gingival index and bleeding on probing was compared with the pain level experienced by the patients.

Probing pocket depth and clinical attachment level

For patients with periodontal breakdown, in addition to gingival index and bleeding scores, the probing depth and clinical attachment level were recorded. Probing depth (PPD) and Clinical attachment level (CAL) denote the intensity of past and present disease activity and hence, comparison of the past disease activity and pain was attempted.

Statistical analysis

The Statistical Analysis was performed using IBM.SPSS statistical software, version 23.0. The measurement data was evaluated in terms of normal distribution by application of the Kolmogrov-Smirnov test. The Chi-Square test was performed to analyse the significance

1). Between the groups;
2). bleeding on probing and pain perceived;
3). Gingival index and pain perception;
4). PPD/CAL with pain scale.

Significance was analysed for all tests performed, whereby a *p*-value of<0.05 was considered to be statistically significant for all tests.

RESULTS.

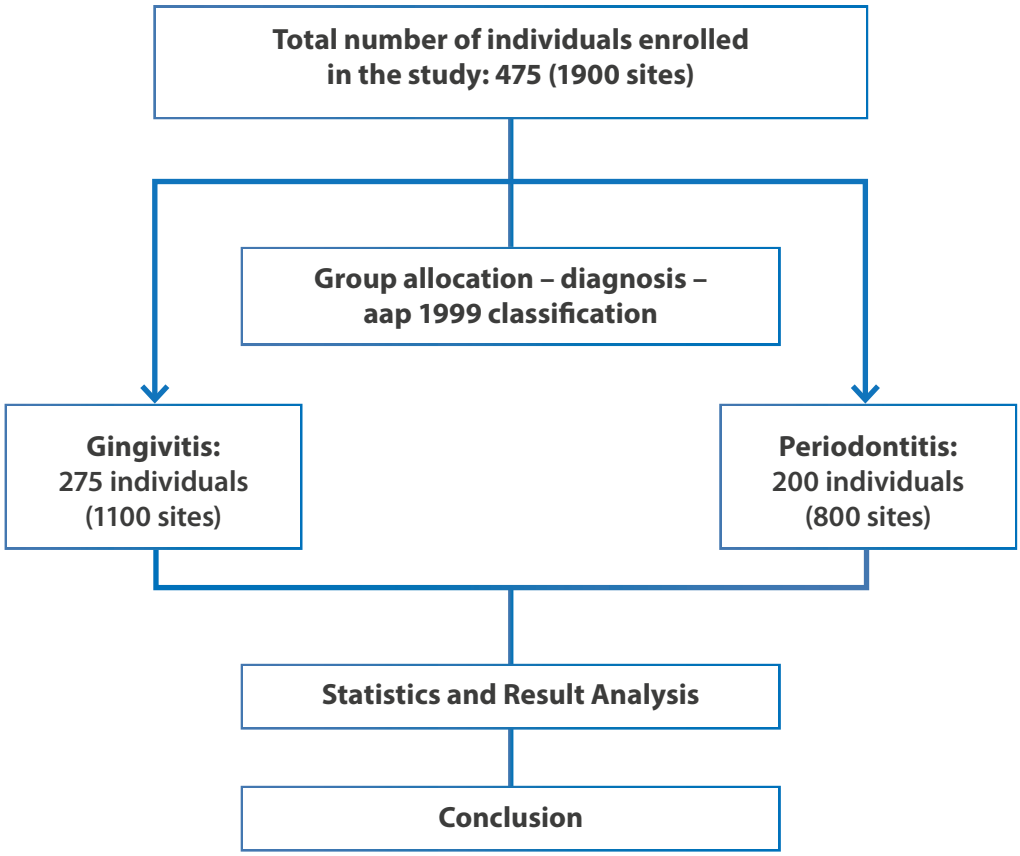
A total of 475 subjects (1900 sites) were recruited into the study within the age range of 18-45 years (Figure 1). Gingival index/teeth, BOP, PPD, CAL and Pain score during probing (HPVAS pain scale) was collected. All study subjects were characterized as having Dental Plaque Induced Gingivitis (Group-A) or Chronic Periodontitis (Group B) based on AAP classification (Table 1).

All 475 study subjects completed the probing examinations as mentioned above, with no adverse events being reported.

Table 2 shows the inter group comparison of pain perception which was analysed using Chi-Square Test. A low pain perception with statistical difference (p<0.001) was noted in group A than group B correlating with the degree of inflammation due to quantitative alterations in the inflammatory infiltrate in the gingival connective tissue.

Table 3 shows intergroup comparison of pain perception with Bleeding on probing using Chi-Square Test. There appeared to be a statistical difference (p<0.001) in pain perception with reduced bleeding on probing in gingivitis group

Figure 1. Representation of the study design.



ISSN Print 0719-2460 - ISSN Online 0719-2479.

Figure 2. Heft- Parker Pain Scale used in the study

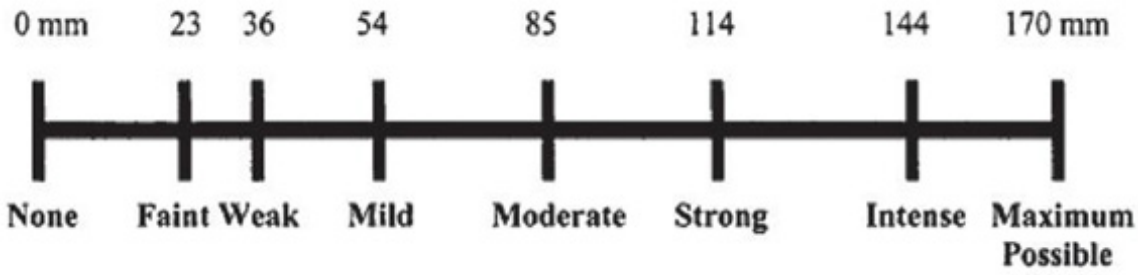


Table 1. Demographic data of individuals enrolled in the study.

		Total	Group A (n=275)	Group B (n=200)
AGE (mean)			32.4	44.4
Gender	Male (n)	285	166	119
	Female (n)	190	109	81
Probing Pocket Depth	0-3mm (n)	301	275	26
	4-5mm (n)	113	0	113
	>5mm (n)	61	0	61
Clinical Attachment Level	0-3mm (n)	299	275	24
	4-5mm (n)	104	0	104
	>5mm (n)	72	0	72

Table 2. Inter group pain comparison using the chi-square test.

Pain Score/Teeth	Group n(%)	Total		Asymp. Sig. (2-sided) *p*-value
		Group A n (%)	Group B n (%)	
None	77 (50.3)	76 (49.7)	153 (100.0)	<0.001*
Faint	72 (21.7)	260 (78.3)	332 (100.0)	
Weak	414 (68.0)	195 (32.0)	609 (100.0)	
Mild	304 (65.2)	162 (34.8)	466 (100.0)	
Moderate	183 (69.6)	80 (30.4)	263 (100.0)	
Strong	35 (62.5)	21 (37.5)	56 (100.0)	
Intense	13 (81.2)	3 (18.8)	16 (100.0)	
Maximum Possible	2 (40.0)	3 (60.0)	5 (100.0)	
Total	**1100 (57.9)**	**800 (42.1)**	**1900 (100.0)**	

*Significant difference between groups (p<0.05)

Table 3. Intergroup comparison of pain score with bleeding on probing, using the chi-square test.

Group	Pain Score/Teeth	Bleeding On Probing; Present n (%)	Absent n (%)	Total n (%)	Asymp. Sig. (2-sided) $p<0.05$
Group A	None	18(23.4)	59 (76.6)	77(100.0)	<0.001*
	Faint	29(40.3)	43 (59.7)	72(100.0)	
	Weak	158(38.2)	256 (61.8)	414(100.0)	
	Mild	138(45.4)	166 (54.6)	304(100.0)	
	Moderate	125(68.3)	58 (31.7)	183(100.0)	
	Strong	22(62.9)	13 (37.1)	35(100.0)	
	Intense	10(76.9)	3 (23.1)	13(100.0)	
	Maximum Possible	1(50.0)	1 (50.0)	2(100.0)	
	Total	**501(45.5)**	**599 (54.5)**	**1100(100.0)**	
Group B	None	25(32.9)	51 (67.1)	76(100.0)	
	Faint	117(45.0)	143 (55.0)	260(100.0)	
	Weak	92(47.2)	103 (52.)	195(100.0)	
	Mild	70(43.2)	92 (56.8)	162(100.0)	
	Moderate	27(33.8)	53 (66.2)	80(100.0)	
	Strong	14(66.7)	7 (33.3)	21(100.0)	
	Intense	1(33.3)	2 (66.7)	3(100.0)	
	Maximum Possible	1 (33.3)	2 (66.7)	3(100.0)	
	Total	**848 (44.6)**	**1052 (55.4)**	**1900(100.0)**	

BOP: Bleeding On Probing. ***:** Significant difference between groups ($p<0.05$)

Table 4. Inter group comparison of pain score and gingivitis score using the chi-square test.

Group	Pain Score/Teeth	Gingival score/Teeth n (%) Mild (%)	Moderate (%)	Severe (%)	Total n (%)	Asymp. Sig. (2-sided) *p*-value
Group A	None	53(68.8)	23(29.9)	1(1.3)	77(100.0)	<0.001*
	Faint	47(65.3)	22(30.6)	3(4.2)	72(100.0)	
	Weak	281(67.9)	127(30.7)	6(1.4)	414(100.0)	
	Mild	189(62.2)	106(34.9)	9(3.0)	304(100.0)	
	Moderate	80(43.7)	95(51.9)	8(4.4)	183(100.0)	
	Strong	14(40.0)	20(57.1)	1(2.9)	35(100.0)	
	Intense	3(23.1)	8(61.5)	2(15.4)	13(100.0)	
	Maximum Possible	1(50.0)	1(50.0)	0(0.0)	2(100.0)	
	Total	**668(60.7)**	**402(36.5)**	**30(2.7)**	**1100(100.0)**	
Group B	None	57(75.0)	19(25.0)	0(0.0)	76(100.0)	
	Faint	174(66.9)	80(30.8)	6(2.3)	260(100.0)	
	Weak	129(66.2)	56(28.7)	10(5.1)	195(100.0)	
	Mild	91(56.2)	63(38.9)	8(4.9)	162(100.0)	
	Moderate	49(61.2)	28(35.0)	3(3.8)	80(100.0)	
	Strong	9(42.9)	10(47.6)	2(9.5)	21(100.0)	
	Intense	2(66.7)	1(33.3)	0(0.0)	100.0	
	Maximum Possible	1(33.3)	2(66.7)	0(0.0)	3(100.0)	
	Total	**1180(62.1)**	**661(34.8)**	**59(3.1)**	**1900(100.0)**	

BOP: Bleeding On Probing. ***:** Significant difference between groups ($p<0.05$)

ISSN Print 0719-2460 - ISSN Online 0719-2479.

relating to the penetration of the probe more or less into the connective tissue with increased level of vascularisation due to ulceration of the sulcular epithelium as a result of inflammation of the periodontium.

Table 4 shows intergroup comparison of pain perception with modified gingival index using Chi-Square Test. subjects with mild gingivitis score showed lower score in HPVAS pain scale with a significance of $p<0.001$ relating to minimal signs of inflammation.

DISCUSSION.

Assessments of periodontal damage are a mandatory component of complete periodontal examination. Measurements of which are well recorded with the use of periodontal probes. There are various generations of periodontal probes. The first generation of probes are considered to be gold standard as they are user friendly and cost effective. One such example is the University of North Carolina Probe-15 (UNC-15 Probe). During clinical examination, 15%-77% of the untreated periodontal patients experience pain.[10]

The pain associated with periodontal probing is mainly due to the inflammation of the periodontal tissues. The pain experienced during this baseline examination procedure has always been a matter of concern but is not taken care of.[15] Hence this study aimed at assessing the pain experienced during periodontal probing in patients with dental plaque induced gingivitis and chronic periodontitis and evaluation of its relationship with gingival inflammatory parameters.

Bleeding on probing, periodontal pocket depth, clinical attachment loss and bone loss gives an overall idea on periodontal disease state. Bleeding on probing is the tendency of the inflamed periodontal tissues to bleed on the slightest provocation, usually probing. It is an objective parameter that is easily assessed clinically (Greenstein *et al.*,[16] In the present study pain experienced by the subjects in correlation with presence of BOP in group B was significantly higher than group A. The results of this study are consistent with available literature. This could be attributed to penetration of the periodontal probe in an untreated periodontal site, into the surrounding connective tissue, which is heavily infiltrated with chronic inflammatory cells. The higher the degree of periodontal inflammation the more the discomfort/pain elicited by periodontal probing along with tendency to bleed due to increase in underlying vascularisation as a result of inflammation.[17]

Visual signs of gingival inflammation are considered to be sensitive indicators of early gingivitis, thus gingival indices based on bleeding have been emphasized. The Simplified Gingival index is non-invasive, logistically simplified and has greater sensitivity.

Similar to other studies the present study also shows a positive correlation between gingival index and presence of bleeding on probing in both groups however it was significantly higher in group B revealing the role of severity in inflammation as a result of periodontal damage.

In periodontitis the presence of ulcerated pocket epithelium with exposure of the underlying connective tissue is noted histologically which on slightest provocation bleeds.[18-19] Underlying inflammation with increased vascularity and neovascularization leading to increase in erythema and the edema being caused by inflammatory infiltrate which is clinically visualized in simplified gingival index showing a positive correlation with presence of BOP.[11,12,16]

The present findings, based on a large sample of 475 patients and 1900 sites, indicate clearly that discomfort during periodontal probing is a significant factor during periodontal probing. These experiences are remembered by patients and may influence their pain perception during the next periodontal treatment. These subjective perceptions may make the patient hesitant about seeking further periodontal diagnostics and/or care. Hence a manual probe with a probing force of 25 Newton's and a proper design of probe tip diameter can reduce the pain elicited during

periodontal recording. In this conscience the manual probe offers the general dental professionals and even periodontists, a low cost when compared to the more advanced computerized systems. This may encourage the general dental professionals to comprehensively evaluate the periodontium, thereby enabling more efficient diagnosis of underlying periodontal diseases.

The present study provides a baseline for further research towards associating the histological and biochemical changes which contribute to the discomfort/pain during periodontal examination.

CONCLUSION.

Within the limitations of the present study, we can conclude that pain perception is directly correlating with the degree of inflammation as seen in periodontitis than with dental plaque induced gingivitis during periodontal probing. Hence, local anaesthesia can be considered to reduce pain levels in severely inflamed patients to foster continuous supportive periodontal therapy acceptance.

ISSN Print 0719-2460 - ISSN Online 0719-2479.

Conflict of interests:

The authors declare that they have no conflict of interest.

Ethics approval:

This study was approved by the Institutional Human Ethical Committee, Chettinad Health City (IHEC No: 470)

Funding:

Self-Funded.

Authors' contributions:

Ashwath.B: Conception and planning of the study; Data interpretation, manuscript preparation, final draft and approval to publish.

Aishwarya.D:Data interpretation, manuscript preparation, final draft and approval to publish.

Agila.E: Data interpretation, manuscript preparation, final draft and approval to publish. Sampling, statistical analysis.

Shanmugam.M: Analysis of results and preparation of the manuscript.

Anitha.V: Analysis of results and preparation of the manuscript. Sample collection, data entry and manuscript preparation.

Acknowledgements:

None.

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ISSN Print 0719-2460 - ISSN Online 0719-2479.