



Original Research Article

The influence of gingival biotypes on periodontal health: A cross-sectional study in a tertiary care center

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ABSTRACT

Background: Dimensional characteristic of gingiva is a predisposing factor for initiation and course of periodontal diseases and conditions. Knowledge about variations of gingival biotype among subjects is a prognostic determinant in Periodontics.

Aim: The purpose of the study was to determine the prevalence of gingival biotypes and to evaluate its influence on various periodontal health parameters.

Setting and Design: Among the patients who reported to the out-patient section, a cross-sectional study was done on those who satisfied the inclusion criteria.

Materials and Methods: Gingival thickness was measured on six anterior teeth of maxillary and mandibular arch using no.15 endodontic spreader and digital caliper by a single examiner on 112 subjects. Another examiner recorded the clinical parameters pertaining to periodontal health. Subjects with gingival thickness ≤ 1.5 mm were categorized to thin and those with ≥ 2 mm into thick gingival biotype.

Statistical Analysis: Difference in mean values of quantitative variables was tested by Mann Whitney U test. Bivariate correlation was assessed by Pearson correlation. Multiple linear regression models were developed for modified gingival index and interproximal attachment loss.

Results: Prevalence of thin and thick gingival biotype was 48.21% and 39.28% respectively. Mean gingival thickness observed was 1.49 ± 0.59 mm. Mean score of all clinical parameters were significantly higher in thin gingival biotype. Gingival biotype had a negative correlation with modified gingival index and interproximal attachment scores.

Conclusion: Thicker gingival biotype can be considered to have a protective effect against the development of periodontal pathology.

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1. Introduction

Periodontal health is a complex entity which is influenced by a multitude of modifiable and non-modifiable risk factors. These inimical factors can affect the initiation, progression and also the severity of periodontal diseases and conditions.¹ Identification of the detrimental factor(s) and understanding the possible mechanism involved will not only help to target the subjects for disease prevention and treatment, but also in modifying the possible risk factor, and

thus forms the pivotal aspects for the control of periodontal diseases. Various studies have documented that the response of periodontium to physical and various treatment measures is dependent on the dimensional characteristics of the tissues.^{2,3}

Gingival biotype is defined as the thickness of gingiva in the labio-lingual direction.⁴ Seibert and Lindhe put forward the categorization of thin-scalloped and thick-flat gingival biotype.⁵ The latest systematic review of gingival morphology proposed the thin-scalloped, thick flat and thick-scalloped classification.⁶ The 2017 World Workshop on the classification of periodontal and peri-implant disease

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and condition has recommended the adoption of the term periodontal phenotype, based on gingival phenotype and thickness of facial and/or buccal bone plate.⁷ Nonetheless, by definition, biotype is genetically predetermined and cannot be modified.

Variations in gingival biotype will result in diversity of the clinical manifestations during periodontal disease process. Hence thin gingival biotype might cope with inflammation by apical migration of gingival margin, whereas thick gingival biotype may exhibit deep pocket formation.⁸ There are conflicting evidences regarding the association of thin gingival biotype with bleeding on probing. In the study by Muller and Heinecke,⁹ it was reported that thin gingival biotype with insufficient keratinized tissue width are not likely to bleed after probing. However, results published by Muller and Kononen¹⁰ showed that sites with thin gingival biotype had higher tendency to bleed. In addition, limited clinical works have been carried out to evaluate the relationship between gingival biotype on plaque accumulation and related changes on periodontium. Hence the present study was conducted to determine the prevalence of different gingival biotype and to analyze its effect on various determinants of periodontal health.

2. Materials and Methods

A cross-sectional study was conducted on 112 systemically healthy Indian patients above 18 years of age, who reported to the out-patient section of Department of Periodontics, Government Dental College, Kottayam. The inclusion criteria were the presence of all anterior teeth in both maxillary and mandibular arch without any restorations, wasting diseases and malalignment. Subjects who were having mouth breathing habit, taking antibiotics, hormonal replacement therapy or any other medications which could alter the gingival morphology, pregnant or lactation mothers, smokers, history of any type of periodontal treatment six months before, as well as those with the history of and/or on-going orthodontic treatment were excluded. The participants were informed about the purpose of the study, amount of discomfort which might occur and informed consent was obtained. The study was approved by the institutional ethical committee (Ref. No. IEC/M/14/2017/DCK dated 15/11/2017).

The gingival thickness was measured by one examiner, based on the method described earlier.¹¹ Briefly, the gingival thickness was assessed mid-buccally in the attached gingiva half-way between the mucogingival junction and marginal gingiva on all the six anterior teeth of both the jaws. After the area was anesthetized using xylocaine spray, a #15 endodontic spreader (Dentsply, India) with a rubber stopper was inserted in a perpendicular direction. The rubber stopper was slid up to the buccal aspect of the gingiva (Figure 1a). The distance from the tip of the spreader

to the rubber stopper was measured using a digital vernier caliper with a resolution of 0.01mm (Figure 1b). From the scores of six teeth, mean gingival thickness of maxillary and mandibular arch separately was calculated. The subjects were classified as having thin gingival biotype (Group I) if the value was <1.5mm and those with measurement \geq 2mm as thick gingival biotype (Group II).¹²

A second examiner, who was blinded about the subject's gingival biotype, recorded the details of the patient on the custom-made proforma to control any bias. Additional data which were recorded to assess oral health condition was the DMFT index, oral hygiene index which is composed of the combined debris Index and calculus Index.¹³ Periodontal health stature was evaluated based on; a) modified gingival index¹⁴ b) pocket probing depth, c) gingival recession and d) clinical attachment level. All the computable values were recorded as full mouth measurement. Each tooth was assessed at 4 sites (mesio-buccal, mid-buccal, disto-buccal and lingual/ palatal). From the total scores obtained, the mean score for the entire dentition was calculated.

2.1. Statistical analysis

The data collected from the study participants was entered into a spreadsheet (MS Excel) and imported into statistical software (IBM SPSS version 24). While quantitative variables (age, oral hygiene index, DMFT, modified gingival index, pocket probing depth, gingival thickness, gingival recession and clinical attachment level) were summarized using mean and standard deviation, frequencies of categorical variables (gender, gingival biotype) were expressed as proportions. Mann Whitney U tests were used to compare differences of quantitative variables between thin and thick gingival biotype groups. Pearsons correlation tests were used to assess bivariate correlation and separate multiple linear regression models were constructed for modified gingival index score and interproximal attachment loss as outcome variables using backward method. P values < 0.05 were considered statistically significant for all tests.

3. Results

The demographic data of study is presented in Table 1. In the study, 112 patients (59 males and 53 females) were examined, of which 54 subjects [27 males out of 53 subjects (50.9%) and 27 females out of 45 subjects (60%)] had thin gingival biotype and 44 subjects [26 males out of 53 subjects (49.1%) and 18 females out of 45 subjects (40%)] had thick gingival biotype. The mean gingival thickness observed from the study was 1.49 ± 0.59 . From the data obtained, the prevalence of thin gingival biotype was 48.21% and that of thick gingival biotype was 39.28%. Data of fourteen subjects could not be included in the analysis as their mean gingival thickness was between 1.5 and 2mm.

The mean age of patient in Group I and Group II was 40.94 ± 9.34 years and 29.3 ± 8.32 years respectively. Mean gingival thickness in males were 1.54 ± 0.6 and in females it was 1.43 ± 0.59 . However, the difference between them were not significant ($p > 0.05$). Mandibular gingival thickness was marginally higher (1.62 ± 1.16) than the maxillary arch gingival thickness (1.56 ± 1.19). Particulars related to oral hygiene practices showed that the majority of subjects (of both the groups) used tooth brush with tooth powder twice daily in horizontal direction (data not presented).

The mean score of all the parameters pertaining to oral health in general and periodontal status in specific were higher in Group I and significant difference was present when compared to thick gingival biotype, (Table 2). For better reflection of periodontal disease, interproximal pocket probing depth, interproximal gingival recession and interproximal attachment loss scores were compared between the groups. The results showed that the subjects with thin gingival biotype had greater mean of scores of all the mentioned parameters and was statistically significant using Mann Whitney U-test.

The correlation of clinical variables with gingivitis (based on modified gingival index score) and periodontitis (based on interproximal attachment loss score) was assessed using Pearson coefficient. The results which are presented in Table 3 show that gingival thickness had a significant negative correlation with modified gingival index and interproximal attachment loss scores. Additionally, oral hygiene index and interproximal gingival recession had a positive correlation with the above-mentioned variables, which was also statistically significant.

Separate multivariable models were constructed using linear regression with modified gingival index and interproximal attachment loss as outcome variables. Out of the four predictor variables in the final model which were statistically significant, gingival thickness had negative correlation with modified gingival index score while oral hygiene index score, pocket probing depth score and gingival recession score showed positive correlation (Table 4). The only two independent variables which were found to be statistically significant to predict periodontitis in the final model were gingival thickness and interproximal gingival recession, of which gingival thickness had a negative correlation (Table 5).

4. Discussion

Morphology and dimension of gingiva differs from subject to subject and even among different areas of mouth. Determination of gingival thickness can be considered to be an important aspect in relation to periodontal treatment, for restorations at esthetic zone, soft tissue augmentation procedures and in implant dentistry.^{3,15,16} The present cross-sectional study was conducted to evaluate the gingival biotype prevalence and its association with general oral

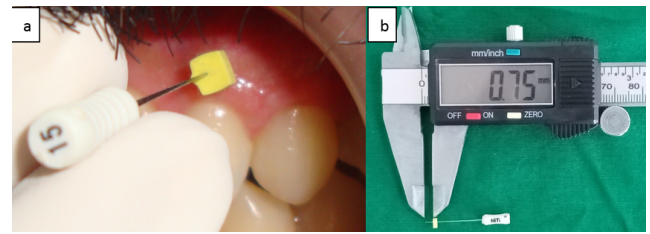


Fig. 1: a: Placement of endodontic spreader with rubber stopper; b: Measurement of gingival thickness using digital vernier caliper.

health and periodontal clinical parameters. Among the varied factors that define gingival biotype, the current study selected the mid-buccal thickness of attached gingiva as the site of assessment.

This study, similar to earlier reports, revealed higher prevalence of thick gingival biotype in younger age group, which could be attributable to the presence of adipose tissue, small mucous glands and increased keratinization.^{17,18} The results of the current study show predominance of thicker gingival biotype in male cohorts, which is in concurrence with earlier studies.^{19,20} However, American Academy of Periodontology best-evidence consensus review by Kim et al summarized that gingival biotype is not influenced by age and gender.⁷

Eventhough the observation of the present study point toward the presence of thick gingival biotype in mandible, which is similar to an earlier report, the difference was not significant when compared with maxillary arch.¹⁷ Diverseness exist in literature regarding the distribution of gingival biotype in maxilla and mandible, with Cuny-Houchmand et al report of thick gingival biotype in maxilla, and Pacual et al conclusion that of soft and hard tissue dimensions of anterior teeth in both the arches are commensurable.^{21,22} The former researchers indicated that a difference may exist between the gingival biotype of maxilla and mandible. Recent evidence-based review summarized that there is no major difference between the overall gingival thickness in maxilla and mandible.⁷

The prevalence of thin biotype ranges from 12%-81% has been mentioned in literature, and is dependent on the definition and methods used to assess the biotype.⁶ Thin gingival biotype was more prevalent than thick gingival biotype among the total subjects who were examined. Other studies have observed a higher prevalence of thick periodontal biotype.^{19,23} Both the studies adopted a different methodology and grading in assessing gingival biotype. As the grading system used in the present study does not consider gingival thickness between 1.5-2mm, there were omissions of data in the final analysis. However it overcomes the thin cutting edge difference of 1mm to differentiate two gingival biotype variants. Also question remains if the cutoff value of 1mm represents the best threshold for diagnostic purposes.²⁴

Table 1: Demographic data.

Parameter	Number of subjects (N=98)	Age (in years) Mean±S.D	Gender distribution of GB		GT (Mean±S.D)	
			Males (N=53)	Females (N=45)	Maxilla	Mandible
Group I Thin GB	54 (55.1%)	40.94±9.34	27 (50.9%)	27 (60%)	1.56±1.19	1.62±1.16
Group I Thick GB	44 (44.89%)	29.3±8.32	26 (49.1%)	18 (40%)		
			N.S(X^2)		N.S(t)	

S.D- Standard deviation; GB-Gingival Biotype; GT- Gingival Thickness;
N.S- Non-significant; X^2 - Chi-square test; t-t-test

Table 2: Oral health parameters of the study groups.

Variable	Group I(Mean± S.D)	Group II(Mean± S.D)	S.S
DMFT	2.59±1.96	2.02±2.86	N.S(t)
OHI	2.41±0.97	1.25±0.55	S#
MGI	1.39±0.73	0.53±0.31	S#
PPD	1.70±0.66	1.24±0.25	S#
GR	1.21±0.86	0.70±0.48	S#
CAL	1.95±1.78	0.80±0.45	S#
IPD	1.34±0.48	0.68±0.26	S#
IGR	1.20±0.57	0.67±0.26	S#
ICAL	1.64±0.68	0.79±0.26	S#

S.D-Standard deviation; S.S-Statistical significance; N.S-Non-significant; S-Significant at $P<0.05$; t- t-test; #- Mann Whitney U test; DMFT-Decayed Missed Filled Teeth; OHI-Oral Hygiene Index; MGI-Modified Gingival Index; PPD-Probing Pocket Depth; GR-Gingival Recession; CAL-Clinical Attachment Level; IPD-Interproximal Probing Depth; IGR-Interproximal Gingival Recession; ICAL-Interproximal Clinical Attachment Level.

Table 3: Correlation of gingivitis (based on MGI score) and periodontitis (based on ICAL score) with clinical determinants.

Variable	Correlation with MGI score	S.S	Correlation with ICAL score	S.S
GT	-0.560	S ^ü	-0.612	S ^ü
OHI	0.468	S ^ü	0.374	S ^ü
IGR	0.301	S ^ü	0.664	S ^ü

S.S-Statistical significance; S-Significant at $P<0.05$; ^ü-Pearson correlation; MGI-Modified Gingival Index; ICAL-Interproximal Clinical Attachment Level; GT-Gingival Thickness; OHI-Oral Hygiene Index; IGR-Interproximal Gingival Recession.

Table 4: Multiple linear regression with gingivitis (MGI) as outcome variable.

Predictor Variables	Unstandardized Coefficients	S.S
GT	-0.341	S‡
OHI	0.200	S‡
PPD	0.302	S‡
GR Score	0.304	S‡

R square=.462, ‡-ANOVA p value<.001, MGI-Modified Gingival Index GT-Gingival Thickness; OHI-Oral Hygiene Index; PPD-Probing Pocket Depth; GR-Gingival Recession; S.S-Statistical significance, S-Significant at $P<0.05$.

Table 5: Multiple linear regression with periodontitis (ICAL) as outcome variable.

Predictor Variables	Unstandardized Coefficients	S.S
GT	-0.406	S‡
IGR	0.591	S‡

R square=.531, ‡-ANOVA p value<.001, ICAL-Interproximal Clinical Attachment Level; GT-Gingival Thickness; IGR- Interproximal Gingival Recession; S.S-Statistical significance, S-Significant at $P<0.05$.

Comparative analysis between the types of gingival biotype based on the clinical parameters of periodontal health was done. Thin gingival biotype variant was associated with more oral hygiene index score and the related features of periodontal pathology. The etiology and pathogenesis of periodontal disease and subsequent destruction of the tissues can be dependent on gingival biotype.¹⁹ Thicker gingival biotype has a greater dimensional stability owing to the presence of lamina bone adjacent to the outer cortical plate that provides the foundation for metabolic support of cortical bone. Absence or scarce lamina bone in thin biotypes predisposes the cortical bone for faster destruction.²⁵ In a similar clinical study on patients with mild or moderate plaque induced gingivitis of age between 18-23 years, the authors reported the higher propensity of bleeding on probing in thin gingival biotype situations.²⁶

Thick gingival tissue is characterized by flat soft tissue and bony architecture with dense fibrotic connective tissue. It affiliates with a sizeable amount of attached gingiva and hence is mostly resistant to trauma. Kao et al described the nature of response of thick and thin gingival biotype to inflammation. The former type shows the tendency for fibrotic changes and formation of periodontal pocket, while the latter form has a more erythematous presentation and predilection for tissue recession.²⁷ This mechanism would explain to a certain extent the identification of higher mean score of modified gingival index score and gingival recession in thin gingival biotype variant in the present study. In contrast to the literature reports, the mean probing depth was higher in the thin gingival biotype group. Different mean pocket probing depth associated with different gingival thickness are in fact an expression of the site specific biologic width.²⁸ Hence a biologically admissible reasoning to the observed discrepancy regarding pocket probing depth can be possible only with the information of biologic width, which was not documented.

2017 World Workshop on the classification of periodontal and peri-implant diseases and conditions mentioned that the key to periodontitis case definition is the presence of interdental clinical attachment loss.²⁹ Hence as a novel investigation, analysis of interdental periodontal health of the two types of gingival biotype was done. Enhanced interdental tissue destruction, based on higher interproximal pocket probing depth, interproximal gingival recession and interproximal attachment loss scores were found in thin gingival biotype subjects. A thin gingival biotype is more prone for interdental tissue destruction as it is associated with a papilla of lesser dimension than that of thick gingival biotype.³⁰ However, lack of radiographic images impeded additional evaluation of interdental areas. Accordingly, future research should be carried out to substantiate the observed clinical informations.

Correlation analysis of gingival thickness with gingival inflammation and periodontal tissue destruction showed a

protective effect of gingival dimension. With a progressive increase of gingival thickness, there was a reduction of gingivitis and periodontitis as evident by the decline of modified gingival index and interproximal attachment loss scores. It can be presumed that the characteristic features of thick gingiva such as large keratinized tissue, flat soft tissue with thick bony plates, location of gingival margin mostly coronal to cemento-enamel junction, provides a better anatomical form which is more resistant to affliction.³¹ In the linear regression model, gingival thickness has been identified as a significant predictor variable for gingivitis (modified gingival index as the clinical parameter) and periodontitis (interproximal attachment loss score as the clinical parameter) with a negative association for both. Similar negative association was also reported by Müller and Könönen.²⁶ In a recent cross-sectional study on subjects with reduced periodontium, the researchers observed that the sites with recession had significantly thinner gingival thickness ($1.28 \pm 0.54 \text{ mm}$).³² Similarly, the current model showing interproximal gingival recession scores as a positive predictor variable upholds the aforementioned relationship.

The results of this cross-sectional study in a tertiary care setting have shown that there are subject and location wise variations in gingival thickness. There is a significant association of gingival biotype with clinical parameters of periodontal pathology. Greater dimensions of gingiva have a seclusive effect on gingival inflammation. The novel attempt to identify the relationship of gingival thickness with periodontitis based on interdental tissue assessment has shown a similar association. However, few limitations to mention with regards to the current investigation are; the lack of assessment of teeth dimensions and non-measurement of bony architecture which could have influenced the gingival morphology. Hence further studies considering the observed limitations and comprising of more number of subjects should be conducted.

5. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

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