Papilla Height as an Objective Parameter to Measure Gingival Biotype

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Abstract: *Background:* There is lack of objective criteria to classify gingival biotype. The aim of the present study is to establish the papillary length - a surrogate parameter, as an objective criterion to classify periodontal biotype as thick or thin in periodontally healthy subjects.

Methods: In 76 periodontally healthy subjects gingival thickness was assessed by probe transparency at the midfacial aspect of both maxillary central incisors. The papillary length between the two central incisors (PL sum 1), the sum of papillary length between central and lateral incisor on either side and between the two central incisors (PL sum 3), the sum of papillary length between canine and lateral incisor, central and lateral incisor on both sides and between the two central incisors (PL sum 5) was calculated. The data so obtained were subjected to statistical analysis to find a correlation between PL sum scores and gingival biotype.

Results: PL sum scores displayed larger PL sum scores for thin biotype group as compared to thick biotype group wherein the mean PL sum 1 score was 4.53 and 4.49mm and PL sum 5 score was 21.8 and 19.83 for thin and thick biotype groups respectively. The difference in the mean PL sum scores for PL sum 1, 3, and 5 were not significant between thick and thin gingival biotypes. According to the binary logistic regression analysis, age was the only significant predictor of gingival biotype (thick/thin). Gender as well as different calculations of PL sum scores had no significant effect on the gingival biotype as outcome. A part of the variation obtained in the biotype was predicted by the sum scores though with a weak canonical correlation of 0.37.

Conclusion: Scores of PL may be used as an objective parameter to assess the gingival biotype of patients which is a variable needed to be evaluated prior to restorative or surgical treatment procedures in order to gain a favourable treatment outcome.

Keywords: Gingival biotype, papilla length, PL sum score, probe transparency, binary logistic regression analysis.

1. INTRODUCTION

The term “Gingival Biotype” is used to describe the thickness of gingiva in faciopalatal dimension [1]. Two basic types of gingival architecture, “scalloped thin” and ”flat thick” have been proposed to illustrate the existence of two different gingival biotypes. Among the factors that may impede success in dental treatments, gingival biotype is the greatest cause of concern, particularly affecting the outcomes of periodontal therapy, root coverage procedures, and implant placement [2-5]. It has been shown that patients with thin gingival biotype are more likely to experience gingival recession following non surgical periodontal therapy [2]. Patients with thick gingiva appear less likely to experience gingival recession after restorative or surgical therapy such as regeneration [6-9]. Further the effect of gingival biotype on implant therapy has also being documented. Thin biotype may lead to marginal bone loss during formation of peri-implant biologic width [10]. Also thin gingival biotype was found to be more prone to angular defects while stable crestal bone was maintained in implants surrounded by thick gingival tissue [11]. Immediate implant placement in a thick gingival biotype offer predictable results. Thus emphasis is laid on the biotype of pink esthetics in dental therapy.

Many non invasive and invasive methods have been used to evaluate the gingival biotype such as conventional histology on cadevar jaws, injection needles, transgingival probing, histologic sections, cephalometric radiographs, probe transparency, ultrasonic devices and Cone Beam Computed Tomography (CBCT) [12]. While the direct measurement of gingival thickness is an invasive method with limitations of reproducibility, non invasive devices could not be established as routine devices owing to technical reasons and cost. Similarly extensive radiographic diagnostics such as CBCT does not appear as an appropriate preliminary choice for defining gingival biotypes. Therefore, visual inspection of the transparency of periodontal probe through the sulcus had become the most frequently used method for discrimination of thick and thin biotypes. Nevertheless the prognostic value of probe transparency is questionable. Therefore, classifying gingival biotype in clinical situations or research is

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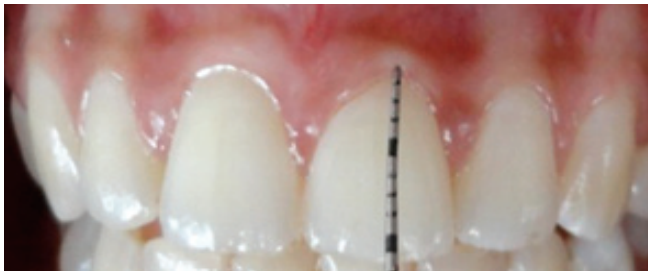
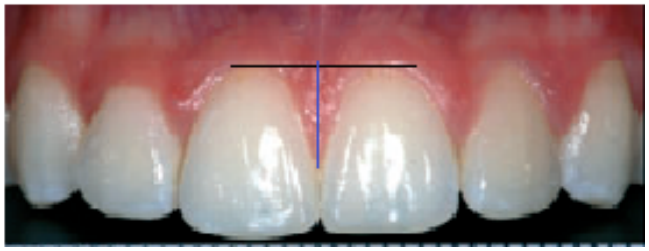
thought to be quite subjective because a precise criterion of classification does not exist. Furthermore, surrogate parameters such as crown form and the height of gingival scallop have also been associated with the presence of a thick or thin gingiva respectively but with inconsistent findings [13]. Nevertheless the advantage of surrogate parameters to differentiate thick and thin gingival biotype is that they are objective in nature rather than the subjective nature of direct measurement, ultrasound devices, CBCT, and probe transparency. The objective parameters are easy to measure and provide a convenient and cost effective chairside diagnostic criteria for assessment of gingival biotype. Thus, the gingival biotype assessed using these objective parameters is beneficial for clinicians to diagnose and treat cases effectively in periodontics, restorative and implant dentistry. Lee *et al.* [1] have shown that the sum of papillary length between each canine and lateral incisor, each lateral and central incisor and between the two central incisors correlates with the gingival biotype. Based on the results of Lee *et al.* the aim of the present study was to establish the papillary length a surrogate parameter, as an objective criterion to classify periodontal biotype as thick or thin in periodontally healthy subjects.

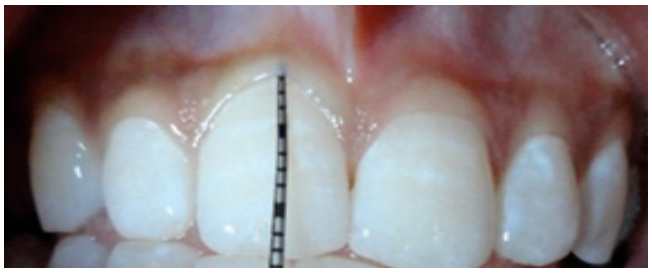
2. METHODOLOGY

A total of 76 volunteers (males and females) above the age 15 years without known periodontal diseases were selected from the attendants of patients reported at the department of periodontics Modern Dental College and Research Centre, Indore, Madhya Pradesh, India. These subjects were screened and subjects who had undergone periodontal treatment in the past, with malaligned teeth, intake of medications known to induce gingival overgrowth or having systemic diseases with gingival manifestations and / or influencing bone metabolism or subjects who had undergone crown restorations or fillings in maxillary anterior region were ruled out. Thus, a total of 48 subjects fulfilled the criteria and were chosen as study subjects. An informed consent was obtained from each subject prior to the study. Data of each subject were recorded in a proforma.

Gingival thickness was assessed by probe transparency following the protocol of Kan *et al.* [14]. A thin periodontal probe (Williams periodontal probe) was inserted into the gingival sulcus of midfacial aspect of both the maxillary central incisiors. If the probe outline was visible through the gingival margin the gingiva was labelled as thin phenotype (score 0) otherwise it was labelled as thick phenotype (score 1). Clinical papillary length[1] was defined as the shortest length from the inter proximal contact point to the vector connecting each of the most cervical points of the clinical crowns. The papillary length between the two central incisors (PL sum 1), the sum of papillary length between central and lateral incisor on either side and between the two central incisors (PL sum 3), the sum of papillary length between canine and lateral incisor, central and lateral incisor on both sides and between the two central incisors (PL sum 5) was calculated. The data so obtained were subjected to statistical analysis.







Mean and standard deviation of the PL sum 1, 3 and 5 in the two gingival biotype categories were calculated. Unpaired t test was applied to note any significant difference in the PL sum scores between the two biotype groups. The data was further analysed to know if the predictor variables significantly predicted the gingival biotype by binary logistic regression and also by discriminant function analysis. Probability value of <0.05 was considered as statistically significant.

3. RESULTS

A total of 48 subjects were assessed for their gingival biotype, 30 belonged to thin biotype, while 18 belonged to thick biotype as assessed by the probe transparency method. The mean PL sum scores

Table 1: Descriptive Statistics and Comparison of Derived Sum Scores (PL Sum 1, 2 and 3) Between the Thick and Thin Biotypes

	Gingival Thickness Type	N	Mean	Std. Deviation	p-value and Significance for Unpaired t Test
PL Sum1	Thin	30	4.53	1.04	0.66, Not significant
	Thick	18	4.39	1.2	
PL Sum 3	Thin	30	13.23	2.39	0.129, Not Significant
	Thick	18	12.11	2.52	
PL Sum 5	Thin	30	21.80	3.97	0.098, Not Significant
	Thick	18	19.83	3.80	

PL = Papilla Length.

Table 2: Binary Logistic Regression with Gingival Biotype (thick/ thin) as Outcome Variable and Age, Gender and PL Sum Scores as Predictor

Variable		B	S. E.	Wald	df	Sig.	Exp(B)
	Age	0.164	0.073	5.038	1	0.025	1.178
	Gender(Female)	1.079	0.772	1.953	1	0.162	2.941
	Pl Sum1	1.184	0.800	2.190	1	0.139	3.268
	PL Sum 3	-0.611	0.719	0.721	1	0.396	0.543
	PL Sum 5	-0.131	0.351	0.140	1	0.708	0.877
	Constant	0.542	2.083	0.068	1	0.795	1.719

PL = Papilla Length.

presented in Table **1** displayed larger PL sum scores for thin biotype group as compared to thick biotype group wherein the mean PL sum 1 score was 4.53 and 4.49mm and PL sum 5 score was 21.8 and 19.83 for thin and thick biotype groups respectively. The difference in the mean PL sum scores for PL sum 1, 3, and 5 were not significant between thick and thin gingival biotypes. (Table **1**) Age, gender and PL sum scores were taken in to consideration as predictors for thick or thin gingival biotype. According to the binary logistic regression analysis, age was the only significant predictor of gingival biotype (thick / thin). Gender as well as different calculations of PL sum scores had no significant effect on the gingival biotype as outcome.

Discriminant functional analysis with gingival biotype as the grouping variable and the three PL sum scores as predictors was done. The eigen value observed was 0.16 and it indicates that only 16% variation in gingival biotype was predicted by the sum scores and a weak canonical correlation of 0.37 was noted. The predictors in the model are not significantly predicting the gingival biotype.

4. DISCUSSION

From a clinical point of view, gingival biotype assessment should include some method to discriminate thin from thick gingiva, because numerous high risk patients may otherwise be overlooked. A simple method of visual inspection of transparency of a probe through the sulcus though is the most widely used technique to assess gingival biotype, is subjective and not reliable. Literature reveals several parameters contributing to the biotype of gingiva which includes crown length, crown width, papilla length and area of crown and papilla [1, 15-17]. Malhotra *et al.* [15] found a highly significant correlation between gingival biotype and crown length and area of papilla. Anand *et al.* [18] correlated the prevalence of thick and thin biotype with gender and tooth morphology.

The present study considered the assessment of papilla length score to correlate with the type of gingiva in comparison with visual inspection using a probe. Only a periodontal probe was used to approximate measurement of this variable. Accordingly, the papilla length measured for subjects having thin biotype as

classified initially by the probe transparency method was greater than that for subjects with thick gingival biotype wherein the mean PL for thin and thick gingival biotype was 4.53mm and 4.39mm respectively (Table **1**). This correlates with the result of Malhotra *et al.* [15] who also found increased PL score for thin (5.13mm) as compared to thick gingival biotype (4.44mm). Also, the PL sum 5 score i.e. the sum of papilla lengths between each canine and lateral incisor, each lateral and central incisor and the two central incisors in thin gingival biotype was greater than thick gingival biotype (21.8mm and 19.83mm respectively) (Table **1**). In a similar study by Lee *et al.* [1], individuals greater than 23.73mm were classified as the high risk thin biotype. Discriminant function analysis performed showed that the sum of the area between each canine and lateral incisor, each lateral and central incisor, and the two central incisors was the best single determinant of biotype and the PL sum 5 score was the next best choice. It was suggested that the value approaching a threshold of 24mm casn give clinicians a warning sign from a practical point of view. In the present study, individuals with thin gingival biotype displayed mean PL sum5 score of around 22mm. The mean PL sum scores when compared among thick and thin biotype subjects did not reveal any statistical significant difference for PL sum 1, 3 or 5. Nevertheless, the scores obtained in the present study does correlate with the trend of the results obtained by previous authors (Table **2**).

Discriminant functional analysis with gingival biotype as the grouping variable and the three PL sum scores as predictors was performed in the present study. Though PL sum scores did not significantly predict the gingival biotype, part of the variation obtained in the biotype was predicted by the sum scores though with a weak canonical correlation of 0.37. Age was the only significant predictor of the gingival biotype when binary logistic regression with gingival biotype as outcome variable was seen. Reports [19, 20] exist in literature regarding the thickness of gingiva varying with age and among gender. In a study [19] on 120 subjects to assess variations in thickness of gingiva, it was observed that the younger age group had significantly thicker gingiva but less width than that of the older age group. Also gingiva was found to be thinner and width less with in females than males. The mandibular arch had thicker gingiva with less width compared to the maxillary arch. A similar study [20] revealed younger age group to be having significantly thicker gingiva than the older age group and was thinner in females than in male subjects. In a study [21] to check for the various anatomic parameters affecting the interdental papilla, gingival papilla appearance was associated significantly with tooth form/shape, crestal bone height and interproximal gingival thickness. Muller *et al.* [22] in their study identified subjects with 3 different gingival phenotypes among young male adults i.e. normal gingival thickness; Cluster A group had normal gingival thickness with high crown width to length ratio (CW/CL), cluster B group comprised of significantly thicker and wider gingiva and a more quadratic form of upper anterior teeth and cluster C subjects with normal gingival phenotype, high CW/CL but a narrow zone of keratinized tissue. While, Muller *et al.* [23] in another study showed that the gingiva to be thicker in the maxilla than in the mandible with the thinnest facial gingiva found at maxillary canines and mandibular 1st premolars, the study results of Vandana *et al.* [20] demonstrated thicker gingiva in the mandible than in the maxilla. Esfahrood *et al.* [12] demonstrated the gingival thickness to be varying at different level of gingiva i.e. at coronal margin (G1), at base of free gingiva (G2), at supracrestal attachment (G3), the middle third (G4), directly above bone crest (G5) and of attached gingiva (G6). Since probe transparency indicates gingival thickness of marginal gingiva i.e. G1-G4 only, its prognostic value remains questionable.

Moreover surrogate parameters such as crown form i.e. squared versus tapered long [16, 17, 26] and height of gingival scallop [24, 25] have also been associated with thick and thin gingiva and needs to be verified. The advantage of surrogate parameters to differentiate thick and thin gingival biotype is that they are objective in nature rather than the subjective nature of direct measurement, ultra sound devices, CBCT or probe transparency. If an association between surrogate objective parameters and gingival biotype is established, it would facilitate the diagnosis and treatment planning in periodontics, restorative and implant dentistry.

Based on the results of Lee *et al.* [1], the present study was an attempt to establish the papillary length as an objective criterion to classify periodontal biotype. The weak canonical correlation displayed in the discriminant functional analysis in the present study suggests the need for a similar study on larger sample size to determine the influence of PL sum scores individually on gingival biotype.

CONCLUSION

Determining papillary length (PL) is a simple, non-invasive chairside technique using only a graduated periodontal probe. Scores of PL may be used as an objective parameter to assess the gingival biotype of patients which is a variable needed to be evaluated prior to restorative or surgical treatment procedures in order to gain a favourable treatment outcome.

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