

Correlation of Gingival Tissue Biotypes with Age, Gender and Tooth Morphology: A Cross Sectional Study Using Probe Transparency Method

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Abstract:

Background: Gingival biotype is a prognostic factor in different therapeutic and regenerative approaches in dentistry. Patients with thin biotype are more prone to recession, inflammation, compromised tissue response, therapeutic and regenerative procedures. Identification of gingival biotypes is therefore important for the treatment planning process in restorative and implant dentistry. The purpose of the study was to evaluate the correlation of different biotypes in individuals with age, gender, varying forms of maxillary central incisors and clinical parameters.

Methods: 200 subjects visiting the outpatient department in the range of 18-50 years participated in the study. Five clinical parameters were recorded by a single examiner. This included the crown width/length ratio (tooth size) of the two central incisors, gingival width, papillary height, probing depth and gingival thickness. The latter was based on the transparency of the periodontal probe through the gingival margin while probing the midbuccal sulcus. The measurements were tabulated and evaluated. Correlation of gingival biotype with age, gender, tooth morphology and other clinical parameters were analysed statistically.

Results: In the univariate analysis sex, age, gingival width, tooth size and pocket depth was found to have significant association with gingival biotype. In the multivariate analysis gingival width, pocket depth and gingival recession were found to be significant. Difference in the results from univariate and multivariate analysis may be attributed to the influence of extraneous factors.

Conclusions: Within the limitations of the present study, following conclusions were drawn. Thicker gingival biotype is associated with short, wider form of teeth while thinner scalloped biotype is associated with long, narrow tooth form. While thicker biotype is more prevalent in male population female population presented commonly with a thin biotype. Thick biotype is seen in younger individuals while older age group shows thin gingival biotype. Increased pocket depth and gingival recession is observed with thin biotype and a decreased pocket depth and gingival recession with thick biotype. Decreased gingival recession and gingival width is associated with thin biotype and increased values of the same with thick biotype.

Keywords: Gingival biotype, Gingival thickness, Periodontal probing

I. Introduction

Clinical identification of biotype helps in better treatment planning and determination of the treatment outcome. Thickness of gingiva varies considerably among different individuals. Gingival thickness has now become an important dimension of interest in periodontics and restorative dentistry from a therapeutic point of view.

In 1969, Ochsenbein and Ross indicated the occurrence of the 2 main morphologic types of gingival that were named as scalloped-thin and flat-thick gingiva. Greenberg et al. determined a periodontal biotype on the basis of gingival thickness measurements using a periodontal probe under local anesthesia^{1,2}. The existence of different periodontal entities or so-called "gingival biotype" may be presented with the bulky slightly scalloped marginal gingiva with short and wide teeth on the one hand and thin highly scalloped marginal gingiva with slender teeth on the other.^{3,4} The term "gingival or periodontal phenotype" has been coined by Muller HP 1997.⁵ The gingiva with thickness less than 1.5 mm was classified as a thin biotype, while the gingiva with thickness ≥ 1.5 mm was classified as a thick biotype.

Since difference in gingival biotype is known to exhibit a significant impact on the outcome of therapy, the identification of the gingival biotype is important in clinical practice. Various studies have shown a wide range of clinical difference in form and appearance in tissue biotypes.⁶ The thick biotype usually demonstrates a

thick bony architecture and is most often found to be prevalent in the population. This type of tissue form is dense and fibrotic with wider zone of attached gingiva, thus making them more resistant to gingival recession.^{6,7} On the other hand, "thin" gingival biotype is delicate, thin with highly scalloped soft tissue with thin bony architecture characterized by bony dehiscence and fenestrations. Such type is more prone to recession, bleeding, and inflammation⁸.

A wide range of methods can be used to measure gingival thickness: both invasive and non-invasive. Gingival thickness can be assessed by direct method, Probe transparency (TRAN) method, Ultrasonic device and Cone Beam Computed Tomography (CBCT) scans. The simplest method proposed to discriminate thin from thick gingiva is based on the transparency of the periodontal probe through the gingival margin.³ The objective of the present study was to identify the existence of gingival biotypes in a sample of periodontally healthy volunteers and to correlate their prevalence in accordance with age, gender tooth morphology and clinical parameters.

Objectives

1. To assess the gingival biotype and study the prevalence and correlation of gingival biotypes of upper central incisors in relation to sex, age and varying sizes of maxillary central incisors
2. To determine the prevalence and correlation of gingival biotype in relation to papillary height, gingival width and pocket depth.

II. Materials and methods

A total of 200 subjects visiting the outpatient department of PMS College of Dental Science and Research, Trivandrum, Kerala, India in the age range of 18-50 years, participated in the study. Periodontally and systemically healthy subjects having all maxillary anterior teeth were included in the study.

The exclusion criteria were as follows:

- Subjects with crown or restorations on maxillary anterior teeth
- Pregnant and lactating females
- Subjects taking medications with any known effect on the periodontal soft tissues
- Subjects with clinical signs of periodontal disease defined as having pockets >3 mm
- Subjects with clinical signs of periodontal disease or clinical attachment loss.
- Mouth breathing habit
- Trauma from occlusion
- Fixed or removable orthodontic treatment
- Rotations, crossbite

A duly signed written consent was taken from all the volunteers before periodontal examination for 5 clinical parameters was carried out. All subjects were provided with oral hygiene instructions and were provided with scaling if necessary.

Clinical parameters

Five clinical parameters were recorded by a single examiner to avoid bias. UNC 15 periodontal probe (Hu-Friedy) was used for assessing the biotype with probe transparency method.

Crown width/ratio length ratio (CW-CL) or tooth size of the right central incisor was determined according to Olsson & Lindhe (1991).⁹ Assessment of width and length were recorded to the nearest 0.1 mm using a calliper. The crown length was measured as the distance between the incisal length of the crown and the free gingival margin on the central incisors, while the crown width was measured as the border between the middle and the cervical portion. Scores obtained from both central incisors were averaged.

Gingival width (GW) was measured mid-facially with a periodontal probe (CPU 15 UNC, Hu-Friedy) to the nearest 0.5 mm. This parameter was defined as the distance from the free gingival margin to the mucogingival junction. Scores obtained from both central incisors were averaged.

Papilla height (PH) was assessed to the nearest 0.5 mm using the same periodontal probe at the mesial and distal aspect of both central incisors. This parameter was defined as the distance from the top of the papilla to a line connecting the mid-facial soft tissue margin of the two adjacent teeth.¹⁰ The mean value was calculated for the three papilla.

Gingival thickness (GT) was evaluated and categorized into thick or thin on a site level. This evaluation was based on the transparency of the same periodontal probe through the gingival margin while probing the sulcus at the mid-facial aspect of both central maxillary incisors.¹⁰ If the outline of the underlying periodontal probe could be seen through the gingiva, it was categorized as thin (Score 0); if not, it was categorized as thick (Score 1). (Figures 1 and 2)

Probing depth (PD) was measured to the nearest 0.5 mm at the mid-facial aspect of both central incisors.

Statistical analysis

For describing patient characteristics standard deviation, mean and percentage was used. Data were entered using Microsoft excel and was statistically analysed using SPSS software. Relationship of biotypes with clinical parameters were assessed using t test and chi square test. It revealed that age and sex were confounders in the univariate analysis and have adjusted in the multivariate analysis. Multivariate analysis was done by unconditional logistic regression methods because the outcome measurement was binary.

III. Results

Frequency distribution of different biotypes among male and female - Among the male population, thicker gingival biotype was observed to be more prevalent (74%) while compared to thin form (26%). Among the female subjects, higher prevalence of thin biotype was found (66%) when compared to males (34%).

Crown width/ length ratio among different gender.- The male population had a ratio of 0.79 and 0.80 of the right and left central incisors respectively. While female population have a ratio of 0.81 and 0.82 of the right and left central incisors, respectively.

Prevalence of different gingival biotypes in with varying forms of upper central incisors in relation to age: Out of the total participants, 140 were in the younger age group (18-30 years) while 60 were in the older age group (30-50 years). Among the young group, more participants had thick gingival biotype (98) than then thinner biotype (42). In the older age group, more prevalence of thinner biotype (36) was seen compared to thicker biotype (24) Evaluation of PH in relation to gingival biotype: The mean PH was found to be 4.7 mm in males and 4.3 mm in females. The PH was found to be lesser in participants with thin biotype as compared to thick biotype Evaluation of gingival width in relation to gingival biotype: Mean gingival width for thick biotype was 4.7 and thin biotype was 3.7 Evaluation of pocket depth in relation to gingival biotype: Mean probing depth for thick biotype was 2.3 and thin biotype was 1.2 (Table 1 and 2)

In the univariate analysis sex, age, gingival width, tooth size and pocket depth was found to have significant association with gingival biotype. In the multivariate analysis gingival width, pocket depth and gingival recession were found to be significant. Difference in the results from univariate and multivariate analysis may be attributed to the influence of extraneous factors.

IV. Discussion

The gingival biotype plays an important role in harmonising ideal esthetics, function and long term prognosis. Clinical appearance of healthy periodontium differs from subject to subject and even among different tooth types. Various factors influence the form of gingival tissue around the natural tooth or fixed prosthesis. Many features are genetically determined; others seem to be influenced by tooth size, shape and position, and biological phenomena such as ageing. The particular shape, topographical distribution and width of the gingiva are clearly functions of the presence and position of erupted teeth. Moreover, tooth shape itself seems to have an important impact on the clinical features of the surrounding gingiva and probably also the underlying tooth supporting periodontal tissues. Variation of morphological characteristics of marginal periodontium have been reviewed in detail by Olsson et al (1993).⁹

The objective of the present study was to evaluate the correlation of different biotypes in individuals with age, gender and varying forms of maxillary central incisors using probe transparency. The study was carried out in 200 periodontally healthy subjects. Only maxillary central incisors were included as reference teeth because differences between biotypes are most explicit for these teeth and because their specific features are easily found in other parts of the dentition.

The method of assessment of gingival biotype ranges from assessment with periodontal probe, or visual examination, ultrasonic devices or radiographic methods. The use of the periodontal probe for penetration within the sulcus was carried out in this study. Kan et al.,¹¹ in their study concluded that the gingival biotype identification with periodontal probe and direct measurement is not statistically different and is adequately reliable and objective. In contrast, study conducted by Olsson et al., demonstrated no significant association between visual and measured gingival tissue forms. Eghbali et al.,¹² also did a study to compare the assessment of gingival biotype in experienced and in experienced clinician. They concluded that simple visual inspection could not be relied as an effective method irrespective of the clinician's experience.

The frequency distribution of GT states thicker biotype in males (74%) as compared to females. Females have more number of thin biotype (66%) while 34% have a thick biotype. The results stated are in agreeable to those with De Rock et al.,¹³ and Muller et al.,¹⁴ who stated 1/3rd of the sample to be females with a thinner biotype. De rock et al. in their study presented that male participants had thicker gingiva to conceal the

periodontal probe when compared to female. Study by Eghbali et al.,¹² documented the presence in 1/3rd of female samples with thin scalloped gingival form while 2/3rd of the male samples with broad band of keratinized tissue and thick flat biotype. They also mentioned that the thin biotype in females was associated with long slender teeth while males showed quadratic teeth with thicker biotype.

The frequency distribution of prevalence of gingival thickness in relation to groups of subjects with different combinations of morphometric data related to central maxillary incisors states that short, wider teeth are associated with thick biotype while long slender teeth are associated with thin biotype. Tooth morphology determines two aspects of gingival scallop. Square teeth produce a shallower gingival scallop, while triangular teeth form just the opposite, a pronounced scallop. The latter predisposes to the so-called 'black triangles'; especially with a thin biotype which has susceptibility for recession. Furthermore, triangular teeth have thicker interproximal bone, resulting in reduced vertical bone loss compared with square teeth, whose thinner interdental bone have a higher incidence of vertical bone resorption. However, squarer teeth yield better interproximal papilla maintenance due to a smaller interproximal distance from the osseous crest to the FGM.

The degree of interproximal fill is also dependant on the periodontal biotype. A thick periodontal biotype encourages interdental fill, while a thinner tissue type creates unaesthetic hollow gingival embrasures. This problem encountered when an implant is placed next to a natural tooth. It is the interproximal bone of the adjacent natural tooth that determines the presence, or absence of a papilla, not the bone surrounding the implant fixture. For thick biotypes, the papilla may be established to normal dimensions of 5 mm, but for thin biotypes, it is difficult to recreate a papilla longer than 4 mm from the osseous crest.

Oschbein and Ross¹⁵ were the first to document the relation of flat thick gingival form with square tooth form and thin gingival biotype with tapered tooth form. Studies by Morris,¹⁶ Lindhe¹¹ documented that individuals with tapered crowns have a thinner biotype, making them more susceptible to gingival recession. Chow and Wang¹⁷ in their review article stated the presence of long narrow form with thin gingival tissue. Seo et al.,¹⁸ in their study did not find any statistically significant differences between the longer and shorter teeth in relation to gingival biotypes.

On comparing the prevalence of gingival biotypes between different age groups, the thicker biotype has been more prevalent in younger age groups. Vandana and Savita¹⁹ in their study on gingival thickness on 32 individuals showed thicker gingiva in younger age group and stated that decrease in keratinisation and changes in oral epithelium may be the contributing factors. Chang²⁰ in his study stated that an inverse relationship is found to be existing between papilla height and age. In the present study, the decreased papilla height has been observed in relation with thick biotype. Sanaviet al.,²¹ in their review article described that the inter root bone is more in the thinner biotype. This in turn can cause more recession. They also stated that the interproximal papilla does not cover the spaces between two teeth in thinner biotype as compared to thick biotype. This could possible relate to increased amount of recession and also the presence of thin biotype in older age group. Chow et al.,²² also evaluated various factors associated with the appearance of gingival papillae and found significant associations with age and the crown form and GT. Olsson et al.,⁹ documented that the central incisors with narrow tooth form had greater amount of recession when compared to incisors with square form. With age, the interdental papilla recedes; this explains the greater frequency of thin biotype seen with older age group. Warasswapati et al.²³ explained that racial and genetic factors contributed significantly for the same.

In a study by Cook et al.,²⁴ they evaluated various gingival parameters in patients having different periodontal biotypes. The results in their study documented no significant differences between tissue biotypes and crown height to width ratio, age, sex and gingival margin position. In the present study, tooth with rotations and malpositions were excluded. But, on a wider range, most number of people are associated with slight malrotations. It should be emphasized that tooth position significantly can alter the gingival parameters. This study emphasises the relevance of determining gingival biotype in periodontal surgeries and implant dentistry. The thicker biotype prevents mucosal recession, hides the restorative margins and camouflages the titanium implant shadows. It also prevents biological seal around implants, thus reducing the crestal bone resorption.²⁵

V. Conclusion

Within the limits of the present study clearly it can be concluded that gingival biotypes have a correlation with age, gender tooth morphology and some clinical parameters. Clinical relevance of these observations has to be tested in longitudinal studies. Since studies have concluded that the thickness of the gingiva plays a vital role in development of mucogingival problems and in the success of treatment for recession and wound healing, assessment of gingival thickness is relevant to clinical periodontics.

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Figures

Figure 1



Figure 2



Legends For Figures

Figure1- Thin biotype- outline of the underlying periodontal probe could be seen through the gingival

Figure 2- Thick biotype- outline of the underlying periodontal probe could not be seen through the gingiva

Table 1: Patient characteristics

Patient characteristics	Thin biotype	Thick biotype
Age	34.95 ± 12.86	25.04 ± 7.17
Sex	22.9% M & 77.1% F	74% M & 26% F
Tooth size	0.80221±0.595E-02	0.7904±1.732E-02
Papilla height	4.390 ± 0.244	4.535 ±0.246
Gingival width	3.736 ± 0.609	4.726 ±0.495
Gingival thickness	43. %	56.5%
Pocket depth	2.305 ± 0.662	1.288 ±0.452

Table 2: Distribution of variables according to gingival thickness

Gingival thickness	Age			Tooth size		Papilla height		Gingival width	
	Mean	±	Median	Mean ± SD	Median	Mean ± SD	Median	Mean ± SD	Median
Thin	34.95	±	29.00	0.802 ± 1.595E-02	.800	4.390 ± .244	4.300	3.736± 0.609	4.000
Thick	25.04	±	23.00	0.790± 1.732E-02	.790	4.535 ±.246	4.700	4.726± 0.495	5.000

Gingival thickness	Pocket depth	
	Mean ± SD	Median
Thin	2.305 ± 0.662	2.000
Thick	1.288± 0.452	1.000

Table 3: Results of univariate analysis

	F	t	P value
Age	81.703	0.000	6.916
Papilla height	1.116	0.292	-4.172
Gingival width	0.779	0.379	12.671
Pocket depth	21.763	0.000	12.890

Table 4: Results of multivariate analysis

	B	P value	Significance
Age	-.055	0.145	NS
Sex	3.217	0.000	HS
Tooth size	65.886	0.010	S
Papilla height	0.762	0.581	NS
Gingival width	4.154	0.000	HS
Pocket depth	0.643	0.587	NS