ORIGINAL ARTICLE

Assessment Of Gingival Phenotype At The Aesthetic Zone In A Malay Population Using Probe Test

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ABSTRACT

Introduction: The gingival phenotype (GP) of teeth at the aesthetic zone often influences dental rehabilitation plans and treatment outcomes. This study aimed to assess the prevalence of GP in the Malay population in relation to gender and age. **Methods:** The GP of 100 patients were determined using the Probe test method. Other clinical parameters were assessed include crown width/crown length (CW/CL) ratio, tooth morphology and width of keratinised tissue. Periodontal parameters were assessed by two calibrated examiners. Data were analysed using descriptive statistics, one-way ANOVA and Kruskal-Wallis test. **Results:** A higher prevalence of thick GP was found at the maxilla for both genders, whereas a thin phenotype was observed at the mandible. At maxilla, both thick and thin GP were found in all age groups, while the mandible showed a higher prevalence of thin GP. Significant differences in GP were found between males and females for mandibular and maxillary anterior teeth and the mandibular lateral incisor ($p<0.05$), while no significant difference was found for other parameters assessed; age group, CW/CL, tooth morphology and WKT. **Conclusion:** Thicker GP is more prevalent in male population and at maxillary anterior. Mandibular anterior GP presented commonly with a thin GP regardless of gender or age-group.
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Keywords: Gingival phenotype, Probe test, CW/CL ratio, Tooth morphology, Width of keratinised tissue

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INTRODUCTION

Gingival phenotypes (GP) or formerly known as 'gingival biotype' is used to describe the three-dimensional gingival volume (1, 2). Historically, in 1969, Ochsenbein & Ross indicated that there were two types of gingival anatomy, flat and highly scalloped. The authors reported that flat gingiva was associated with a tapered tooth form. The authors also proposed that the gingiva mimics the contour of the underlying alveolar bone. The term 'periodontal biotype' was later used by Seibert & Lindhe in 1989, who classified the gingiva as either 'thin-scalloped' or 'thick-flat'. For years, GP has been simply classified into 'thin' and 'thick' phenotypes (1).

Gingival phenotypes is one of the most important factors that could influence the final aesthetic result of

dental treatments. It has been suggested that a direct co-relation exists with the susceptibility of gingival recession followed by any surgical procedure or orthodontics treatment (3, 4). Furthermore, Claffey and Shanley (1986) reported that patients with <1.5mm thin GP and initially non-bleeding sites, displayed mean loss attachment of 0.3mm as compared to thick GP after non-surgical periodontal treatment (5). It is reported that, a greater marginal tissue recession around implants also has been correlated with thin GP (6, 7). Therefore, GP have substantial importance in the decision-making process and should be evaluated at the beginning of the treatment plan for the most aesthetic treatment results.

A variety of methods can be used to measure gingival thickness, either invasive or non-invasive. Gingival thickness can be evaluated by a direct method such as the Probe transparency method (TRAN Method/ Probe test), Ultrasonic device and Cone Beam Computed Tomography (CBCT) scans (2, 8). Currently, the World Workshop recommends assessing the GP using the TRAN method (1). It is the simplest, cheapest and accurate method proposed to discriminate thin from thick gingiva

is based on the transparency of the periodontal probe through the gingival margin (9). The probe will be visible in thin GP (≤1mm) and will not be visible in thick GP (≥1mm) (1).

Limited studies reported on the gingival phenotype in Malay populations. Thus, the main objective of this study was to assess the prevalence of thick and thin GP according to gender and age in the Malay population. The second objective was to determine the differences between GP of different anterior teeth of maxillary and mandibular according to gender, age, the morphology of the teeth, crown-width ratio and width of keratinised tissue. The probe test method was used to discriminate the types of GP.

MATERIALS AND METHODS

Study population
This is a cross-sectional study design, matched by gender of 100 Malays; 51 males and 49 females aged between 19 to 50 years old. This study obtained ethical approval from IIUM Research Committee (ID No: IREC 2018-036). An informed written consent for involvement in the study and taking an intraoral photo was obtained from all participants prior to their involvement in the study.

The study targeted that 10% of the total is margin of error in determining the number of sampling. Based on the total of 282,345 Kuantan population people in 2017. Yamane sampling technique (1967) was used as a benchmark for determining the number of sample sizes to be used in this study.

$$n = \frac{N}{1 + N\alpha^2} \qquad n = \frac{282345}{1 + 282345(0.10)^2} \qquad n = 99$$

Based on the above approach, at least 99 dental patients from Kuantan were randomly selected for this study.

The inclusion criteria were as follows; subjects presenting with all anterior sextants teeth, subjects presenting with good to fair oral hygiene without obvious clinical signs of gingival inflammation or periodontal probing does not exceed 3 mm, and they were systemically healthy. The exclusion criteria were as follows; subjects with crown restorations or fillings that involved the incisal edge on anterior teeth; pregnant or lactating women, and subjects taking medication with any known effect on periodontal soft tissues (e.g.: anti-hypertensive medications).

Prior to the data collection, an inter-examiner calibration was performed between investigators (MA, AS, MY, JS). MY and JS act as the gold standard clinicians. Two investigators (MA and AS) were responsible for assessing all parameters. The calibration of 72 teeth showed a kappa score within the range of 0.692 to 0.852, which showed no significant difference.

Clinical identification and scoring
The parameters that were evaluated included probing depth (PD), gingival phenotype (GP), gingival recession (GR), a width of keratinised tissue (WKT), crown width & length ratio (CW/CL), and the tooth morphology (TM). All the measurements were made on six anterior maxillary teeth at the mid-buccal area of the tooth, that is, the right and left canines, lateral incisors, and central incisors. The data were taken from sextant 2 and sextant 5.

The evaluation of GP was based on the transparency of the periodontal probe using the probe test. The Williams probe was inserted into the mid-facial aspects of the gingiva under the bright light and assessed for the types. When the probe was visible, it categorised as thin (Figure 1a) , and when the probe was not visible, it categorised as thick (Figure 1b) (1). The thin GP was scored as 1, while the thick GP was recorded as 2.

The crown dimension was measure by calculating the ratio between crown width/length. The measurement made according to apparent width and length of the teeth from anterior view. Crown width is measured at the widest mesio-distal width of the crown in mm with an accuracy of 0.5mm. The crown length is measured as the distance between the incisal length of the crown and the free gingival margin of the tooth in mm with an accuracy of 0.5mm using Williams probe. Tooth morphology was assessed by visual inspection and classified into the taper, ovoid, and square shapes. WKT was measured at the mid-buccal from gingival margin to the mucogingival junction using Williams probe (10). It was classified into low (less than 2mm) and high (equal to or more than 2mm) width of keratinized gingival tissue based on a study by Lang and Loe in 1972. Gingival recession was measured as the distance from the gingival margin to cement enamel junction in mm with an accuracy of 0.5mm using Williams probe.

Statistical Analysis
The chi-square descriptive statistic is used to study the prevalence of gingival phenotype in relation to gender and age group. The one-way ANOVA, Independent t-test and Kruskal-Wallis test are used to analyse the objective 2. The K-mean clustering method is used to classify the

Figure 1: (a) thick gingival phenotype on tooth 11 (b) thin gingival phenotype on tooth 13

CW/CL into two clusters which are long-narrow(N) and short-wide(W). For GP group analysis according to the maxillary and mandibular jaw, the mean score of GP was calculated by the sum GP score of the assessed jaw and divided by the number of teeth assessed. The mean score of <1.4 is considered thin, and ≥1.5 to 2 is considered a thick GT.

RESULTS

The study population consisted of 100 Malay patients with healthy periodontal tissue, including 51 males and 49 females with age groups ranging from 19-50 years old. Largely the samples size was from the younger age group compared to the older age group due to the exclusions criteria that limit the older age group's participation.

Table I shows a significant difference of GP between both genders for maxillary and mandibular. The p-value is 0.014 and 0.024, respectively. For the anterior teeth, the male showed thicker GP compared to the female, whereas both genders generally showed a thinner phenotype for mandibular anterior teeth. In contrast, no significant difference found between the group of age according to the maxillary and mandibular gingival biotype. Both p-value are 0.876 and 0.542 respectively. All age groups generally showed thicker GP for anterior maxillary teeth than mandibular lower anterior teeth.

Tables II show no significant differences between the CW/CL ratio of the maxillary incisors according to the maxillary GP and between the CW/CL ratio of the mandibular central incisor according to the mandibular GP. However, there is a significant difference of mandibular lateral incisors GP according to the CW/CL ratio, which is 0.021.

Table III shows no significant difference between the tooth morphology of the maxillary right central incisor (11) and mandibular left central incisor (31) according to maxillary and mandibular GT. Both p-value are 0.767 and 0.752 respectively.

Table III: The differences in shape of maxillary right central incisor (11) and mandibular left central incisor (31) according to GP. (N=100)

	Tooth 11			Tooth 31*	
TM (n)	Mean (SD)*	P-value*	TM (n)	Mean (SD)	P-value*
Taper (27)	1.55 (0.51)	0.767	Taper (98)	1.25 (0.31)	0.752
Ovoid (7)	1.43 (0.54)		Ovoid (1)	1.00 (0.00)	
Square (66)	1.50 (0.50)		Square (1)	1.00 (0.00)	
Total (100)	1.50 (0.50)		Total (100)	1.24 (0.31)	

*P value<0.05 is consider significant different.; *Kruskal Wallis test.*

Table IV shows that all maxillary anterior has high WKT (n=100) with mean (±SD) of GP of 1.40 (± 0.34). While two patients showed low WKT for mandibular anterior however no significant difference of GP between the low and high WKT group. The P-value is 0.937.

DISCUSSION

The gingival phenotype undoubtedly influences the aesthetic outcomes of various dental treatments. Thus, the evaluation of GP during the diagnostic assessment

Table I: The Maxillary and Mandibular GP according to gender and age-groups (N=100)

	Maxilla GP		Mandible GP	
	Mean (SD)	P-value	Mean (SD)	P-value
Gender (n)				
Male (51)	1.48 (0.38)	0.014	1.31 (0.33)	0.024
Female (49)	1.31 (0.32)		1.17 (0.27)	
Total	1.40 (0.34)		1.24 (0.31)	
Age-group (n)				
19-30 (84)	1.40 (0.35)	0.876*	1.23 (0.31)	0.542*
31-40 (12)	1.39 (0.36)		1.32 (0.28)	
41-50 (4)	1.48 (0.21)		1.25 (0.33)	
Total	1.40 (0.34)		1.24 (0.31)	

*P value<0.05 is consider significant different. *Kruskal Wallis test.*

Table IV: The differences of maxillary and mandibular GP according to width of keratinized tissue (WKT). (N=100)

	Maxilla			Mandible		
WKT(n)	Mean of GP (SD)	P-value	WKT(n)	Mean of GP (SD)*	P-value*
Low (0)	-	-	Low (2)	1.25 (0.35)	0.937
High (100)	1.40 (0.34)		High (98)	1.24 (0.31)	
Total	1.40 (0.34)		Total	1.24 (0.31)	

*P value<0.05 is consider significant different. *Kruskal Wallis test.*

Table II: The differences in tooth dimension (CW/CL ratio) of the Maxillary and Mandibular incisors according to GP. (N=100)

		Central incisors			Lateral incisors	
	CW/CL ratio (n)	Mean of GP (SD)	P-value*	CW/CL ratio (n)	Mean of GP (SD)	P-value*
Maxilla	N: 0.74 (47)	1.44 (0.47)	0.202	N: 0.71 (58)	1.30 (0.38)	0.175
	W: 0.89 (53)	1.56 (0.47)		W: 0.89 (42)	1.41 (0.44)	
	Total	1.50 (0.47)		Total	1.35 (0.40)	
Mandible	N: 0.61 (80)	1.35 (0.46)	0.110	N: 0.66 (73)	1.30 (0.38)	0.021
	W: 0.81 (20)	1.19 (0.38)		W: 0.84 (27)	1.41 (0.44)	
	Total	1.23 (0.40)		Total	1.35 (0.40)	

*P value<0.05 is consider significant different, Long-narrow teeth(N), Short-wide teeth(W). *Kruskal Wallis test.*

of soft tissue around the teeth is substantially important in the treatment decision-making process (1). This study assessed the prevalence of the gingival phenotype of aesthetic zone teeth in 100 samples of the Malay population-based on transparency through the gingival sulcus. Subsequently, determine the differences between GP of maxillary and mandibular according to gender, age, the morphology of the teeth, crown-width ratio and width of keratinised gingival tissue.

The GP can be assessed by both invasive and non-invasive techniques. This includes simple visual examination, probe transparency test, ultrasonic device and cone-beam computed tomography (CBCT) (2, 8). However, the visual inspection is not reliable as it has some flaws found in previous studies (9). In addition, Eghbali et al. in 2009 from their study on the assessment of GP with experienced and inexperienced clinicians, also concluded that visual inspection might not be a reliable method to identify GP as almost half of the gingival biotype was overlooked (14). The ultrasonic device was introduced for measuring gingival thickness by Eger et al. in 2007 (15). It is an example of a non-invasive technique along with visual inspection and probe test. However, the ultrasonic device has problems assessing difficult posterior sites (16). In other hand, the CBCT technique is an accurate technique with a minimal discrepancy between clinical and radiographic measurements for the GP assessment. However, the radiation exposure and high-cost procedure make the CBCT less popular (17). We decided to adopt the probe test method because it is a simple, cheap, and less traumatic procedure (2). Furthermore, De Rouck et al. (2009) found that this method has a high reproducibility in their study (11).

The present study notably demonstrates Maxillary GP is thicker in males in comparison to females. The findings concurred with the previous reported studies (11, 16, 18, 19). Contrarily, Mandibular GP is thinner for both genders and across different age groups suggesting the existence of GP differences between Maxilla and Mandible in the same patient. To shore up the above findings, Agarwal and co-workers (2017) reported a thicker GP in the maxilla and a thinner GP in the mandible(20) despite different age groups. Furthermore, Raisa and Waseem (2017) reported their study of the Kashmiri population and found no association between age and GP(21).

Regarding the link between GP with tooth dimensions, a tapered crown tooth form with a small proximal contact area seems to be associated with thin gingival GP (13). Meanwhile, a short or wide anatomical crown with a relatively large proximal contact area shows thicker GP characteristics (12,13). Even though statistically insignificant, the present study findings for the Maxilla GP concurred with the latter. While the thinner phenotype was more frequently identified for the mandible regardless of types of tooth morphology. Notably, this study observed that mandibular lateral incisors show significant differences between GP of narrow and wide tooth dimensions. Olsson et al. (1993) and Seo et al. (2006) also unable to find any significant influence between the shorter and longer teeth with the different types of GP (22,23). In fact, further determination of GP for specific teeth 11 and 31 according to different tooth shapes (taper, avoid, square) did not show any statistically significant differences. However, in a study by Jae-Won et al. (2017), they stated that the tooth shape and gingival form were significantly correlated with a coefficient of -0.36 for maxillary central incisors (25).

The present study did not find any significant relation between WKT type and GP. Nevertheless, Olsson and colleagues in 1993 had reported that, there were significant differences between the gingival thickness of central incisors and the WKT through regression analysis (22). They determined the gingival biotype-using caliper rather than the probe test. Perhaps, this might influence the ability to discriminate more effectively the gingival type. Many previous studies on GP only assessed the Maxillary teeth, particularly the central incisors, and their studies did not discriminate the GP according to arches. The results of this study somewhat suggest that a different should be observed between the GP in the maxilla and mandibular anterior teeth.

CONCLUSION

Within the limitation of this study, we can conclude that in the Malay population thicker GP is more prevalent in male population and at maxillary anterior. Mandibular anterior GP presented commonly with a thin GP regardless of gender or age-group. The subject's gender can be a reliable reference for routine clinical determination of GP. For future studies, the measurement of gingival thickness and other independent variables (crown width/crown length ratio, gingival thickness, width of keratinised tissue) can be improved by using a calibrated calliper and discriminate maxillary and mandibular GP. Sample size should also be matched according to age group and maybe consider other subpopulations in Kuantan to obtain a valid comparison.

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