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Gingival Biotypes Identification Among Malay Subjects

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ABSTRACT

Gingival biotypes play an important role in the prognosis and treatment outcome of the prosthodontics and periodontal plastic procedure at the aesthetic region. This study aimed to identify and compare the gingival biotypes between male and female subjects of Malay population related to the upper incisor teeth. 24 males and females aged from 18 to 47 years old who fulfilled all the inclusion criteria were selected. The gingiva and the incisors morphometric were examined and measured using William's periodontal probe. Crown width and crown length ratio (CW/CL), gingival width (GW), papilla height (PH), probing depth (PD) and gingival thickness (GT) were recorded. William's probe was inserted into the gingival sulcus and the transparency of probe determined the gingival thickness. Data was analysed using SPPS version 22.0 and non-parametric test was employed. Statistical significant was set at $p<0.05$. Result showed that more than 80% of subjects having thin biotypes at upper anterior region. There was no significant difference of the gingival biotypes between male and female subjects ($p=0.68$). In conclusion, this study demonstrated that thin biotype is the main biotype in Malay population. Therefore, it is recommended that management of anterior region in Malay patient necessitates careful and proper treatment procedures as thin gingival biotypes may influence tissue response and disparities in the aesthetic outcome.

Keywords
Gingival biotypes; Aesthetic; Malay population

Introduction

A key determinant pertaining to restorative treatment is knowledge regarding gingival biotype. The term 'gingival phenotype' is employed to represent the changes with regards to gingival width and thickness, particularly near the facial region. Gingival biotype signifies the gingiva's thickness as well as three other key characteristics, including gingival width, papilla height and width/height ratio of the crown. Numerous researchers have put forward different forms of gingival biotypes. As per Ochsenbein & Ross [1], there are two types of biotype, i.e., the thick and flat or the scallop and thin. Later, Seibert and Lindhe [2] stressed on this as 'thin-scallop' and 'thick-flat' biotype. The thick biotype was defined to possess ≥ 2 mm thickness and the thin biotype was defined to possess ≤ 1.5 mm thickness. However, De Rouck et al. [3] highlighted both the gingival thickness as well as the measurement of the width to length ratio pertaining to the central incisors, the keratinised gingiva's width, and the papilla's height.

The gingiva's thickness has an impact on its response to trauma and inflammation. When compared with thin biotype, the thick biotype is regarded to be more fibrotic, denser and resilient in fighting against periodontal attachment loss as well as recession because of trauma and infection. Generally, in periodontal surgery, the thin biotype can be linked to the recession after treatment of the implant [4, 5, 6]. Thick biotypes, on the other hand, have high collateral blood supply which enhances the healing outcome with regards to the periodontal surgery.

From an aesthetic perspective, the metal substructures that are commonly employed in prosthodontics treatment (particularly in porcelain that is fused to the metal crown) have been observed majorly in thin biotype, which in turn compromises the aesthetic value [7]. Thus, for thin biotype, supragingival margin preparation has been regarded to be a better option. Also, employment of retraction cord in margin preparation or impression has been seen to be involved with recession in thin biotype.

Invasive or non-invasive methods can be used to assess gingival biotype. In the non-invasive method, probe transparency method (TRAN method), cone beam computer tomography (CBCT) and ultrasonic device can be employed for direct visual evaluation. In the invasive method, spreaders, periodontal probe and callipers are employed for direct measurement. Our study is aimed at measuring the gingiva's thickness in Malay population by employing the non-invasive method.

Methods

A cross sectional study was conducted on 48 volunteer Malay subjects with age ranging from 18 to 47 years old. The subjects comprised of 24 males and females respectively who presented with healthy periodontal status and having all maxillary front teeth. The exclusion criteria were; presence of filling /crown restorations involving the anterior maxillary teeth, pregnant or lactating mothers, and subjects taking medication known to affect the periodontal tissues. Subjects were provided with tooth polishing. The research information was explained and consent was taken. Intra and inter-examiner calibration was carried out prior to procedure. The assessment of the gingival characteristic and tooth form was performed on all maxillary incisor teeth while patient lying supine on dental chair. The measurement was conducted using the Michigan 'O' William's periodontal probe. The parameters measured were as follows (Figure 1):

1. Crown width (CW): The crown width was measured mesio-distally at the border between middle and the cervical portion (Figure 1a), based on Olsson and Lindhe (1991)
2. Crown length (CL): The length of the crown was measured from the incisal edge till the free gingival margin (Figure 1b), based on Olsson and Lindhe (1991)
3. Gingiva width (GW): It was measured at midfacially to the nearest 0.5mm from free gingival margin to the mucogingival junction (Figure 1c)
4. Papilla height (PH): It was assessed to the nearest 0.5mm at the mesial aspect of both central incisors and lateral incisors from the apex of papilla to a line connecting the midfacial soft tissue margin of the two adjacent teeth (Figure 1d), based on Olsson et al., (1993)
5. Probing depth (PD): This parameter was measured by probing at the midfacial aspect of both central incisors and lateral incisors to the nearest 0.5mm. (Figure 1e).
6. Gingival thickness (GT): This evaluation was based on the transparency of the periodontal probe through the gingival margin while probing the sulcus at the midfacial aspect of all maxillary incisors known as the Probe Transparency Method (TRAN) ([3]; [4]). If the outline of the underlying periodontal probe could be seen through the gingival (Figure 1g), it was categorized as score 0= thin; if not, it was categorized as score 1= thick (Figure 1g). This resulted in three possible scores on a patient level: 0 (both central incisors/lateral incisors with score 0), 1 (one central incisor with score 1) or 2 (both central incisors with =score 1).

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Interrater reliability

The intraclass correlation coefficient was used to analyze inter-rater reliability. The reliability between examiners was 0.993. In addition, means of percentile agreement was also done for all the parameters and 85% of the assessed CW, CL, PH, PD and GT were in agreement to each other within 0.5mm deviation.

Figure 1. Assessment of a) Crown width (CW) b) Crown length (CL) c) Gingiva width (GW) d) Papilla height (PH) e) Probing depth (PD) f) Thick gingival biotype (Note:the probe tip cannot be seen underneath the gingival pocket) g) Thin gingival biotype (Note: the transparency of the probe tip inside the pocket)

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Data Analysis

SPSS version 22.0 was used for data analysis. Descriptive statistic was calculated and expressed by median (IQR) and frequency for numerical and categorical variables respectively. For the continuous variables (crown width, crown length, gingival width, papilla height, probing depth and gingival thickness), the non-parametric Mann Whitney test was used to evaluate differences between gender and clusters. Comparisons of gingival biotype between genders was analysed by Fisher's exact test. Cluster analysis of non-hierarchical type was used to form clusters of distinct characteristics amongst the subjects. P value <0.05 is considered significant at 95% Confidence Interval.

Results

Table 1 shows the median and interquartile ranges of the central and lateral incisors' morphometric measurements. The crown width/crown length ratio refers to the general form of the respective incisors with a higher value typically favoring a more bulbous and wider crown form while a lower value refers to a more slender and longer crown form. In general, the morphometric characteristics of anterior region of male and female Malay subjects are not significantly different except for the crown width of the lateral incisors (p = 0.01). Table 2 shows the frequency distribution of the gingival thickness of both central and lateral incisors in male and female subjects. The gingival thickness is relatively similar between male and female subjects, however, 56.2% of the central incisors and 64.6% for the lateral incisors show a uniformly thin biotype. For the combined biotype, both male and female subjects show mostly in uniform thin biotypes (83.3% and 87.5% respectively). The biotypes of male and female were almost similar characteristic (p = 1.0)

Table 1. Clinical characteristics of tooth form and gingiva in 48 subjects [median (IQR)]

Parameter	Male	Female	P-value
Crown width/ crown length ratio of central Incisors	0.81(0.10)	0.80(0.16)	0.836
Crown width/ crown length ratio of lateral incisors	0.80(0.17)	0.77(0.21)	0.343
Average gingival width (mm)	4.82(2.53)	4.63(1.87)	0.620
Average papilla height (mm)	4.00 (1.69)	3.87 (1.38)	0.288
Average crown length of central incisors (mm)	11.25 (2.00)	11.25 (0.94)	0.416
Average crown width of central incisors (mm)	10.0 (1.00)	9.25 (1.75)	0.160
Average crown length of lateral incisors (mm)	10.0 (2.75)	9.00 (1.94)	0.136

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Average crown width of lateral incisors (mm)*	7.87 (1.19)	6.87 (0.94)	0.011
Average pocket depth (mm)	1.00(0.44)	1.00(0.35)	0.744

*Significant difference detected using Mann-Whitney U test.

Table 2. Frequency distribution for gingival thickness of the central and lateral incisors.

	Score	Male n (%)	Female n (%)	Total n (%)
GBCI	Score 0	14 (58.3)	13 (54.2)	27 (56.2)
	Score 1	5 (20.8)	6 (25.0)	11 (22.9)
	Score 2	5 (20.8)	5 (20.8)	10 (20.8)
GBLI	Score 0	15 (62.5)	16 (66.7)	31 (64.6)
	Score 1	4 (16.7)	4 (16.7)	8 (16.7)
	Score 2	5 (20.8)	4 (16.7)	9 (18.8)
Gingival thickness	Score 0	20 (83.3)	21 (87.5)	41 (85.4)
	Score 1	4 (16.7)	3 (12.5)	7 (14.6)

GBCI= Gingival biotype of central incisors; GBLI=Gingival biotype of lateral incisors

Cluster analysis

Using the morphometric parameters in Table 3, two clusters were formed from the total 48 patients. Majority of patients (72.9%) fall into cluster 1 (Figure 8a) which was characterized by a more narrow and slender form of crown with less gingival width (or keratinised gingiva), longer papilla height and shallower probing depth compared to cluster 2. Cluster 2 (Figure 8b), was characterized by wider and shorter form of crown with more gingival width, shorter papilla height along with deep probing depth. Both clusters showed significant difference in all of their morphometric parameters [crown width/crown length ratio of central incisors ($p < 0.001$), crown width/crown length of lateral incisors ($p < 0.001$), average gingival width ($p <0.001$), average papilla height ($p = 0.001$) and average probing depth ($p = 0.007$)]. Even though both clusters 1 and 2 are presented with different morphometric parameters, they presented with a similar gingival biotype, which is predominantly the thin biotype, with a frequency of 33 and 8 respectively (Table 4).

Table 3. Clinical parameters of tooth and gingiva per cluster [median (IQR)]

Parameter	Cluster 1	Cluster 2
Frequency (%)	35 (72.9)	13 (27.1)

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Crown width/length ratio of central incisors*	0.79 (0.13)	0.96 (0.13)
Average gingiva width* (mm)	4.63 (1.90)	6.59 (1.90)
Average papilla height* (mm)	3.92 (1.29)	2.93 (1.29)
Average probing depth* (mm)	0.92 (0.28)	1.27 (0.28)

*= Significant difference between cluster 1 and 2

Figure 8. The clinical example of subject in (A) Cluster 1 and (B) Cluster 2.

Table 4. Frequency distribution for gingival biotype in each cluster

Cluster	Score 0 n (%)	Score 1 n (%)	P-value
1	33 (94.3)	2 (5.7)	0.011
2	8 (61.5)	5 (38.5)	

*Fisher's exact test; Significant difference of gingival biotype in cluster 1 and cluster 2 (P= 0.011)

Discussions

The success of a dental restoration also includes aesthetics as one of the contributing factors. The pink (gingiva) and white (teeth) aesthetics concept focusses on maintaining an absolute harmony between restoration and the nearby tissues. Often, when a patient is receiving treatment, the white aesthetics would be the primary focus, while little attention would be paid to pink aesthetics. To get a perfect outcome, the surrounding soft tissue also needs to be assessed from the start of the therapy. The gingiva biotype is regarded to be a key factor that helps to determine the dental treatment results. The gingiva's thickness impacts the response to trauma due to any dental treatment, an implant's success as well as the outcome and prevalence pertaining to periodontal

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therapy. In the current study, we have employed the non-aggressive method to measure the gingival biotype for the experiment. We have employed this technique as it is less aggressive, widely accepted and cost-effective. Even though other instruments, including the ultrasonic device, are regarded to be reproducible [10, 11], there is a challenge of maintaining direction pertaining to the transducer, and the tool involve high costs. Also, even though the cone beam computed tomography (CBCT) offers accurate measurement [12], it requires technical expertise and poses the risk of exposing the patient to radiation that is unnecessary.

As per the study results, there was no significant difference between female and male Malay subjects with regards to gingival width, probing depth, papilla height as well as crown width/length ratio pertaining to all the involved teeth. Yuan et al. [13] also found a similar finding in their measurement for crown width/length ratio of Indonesian sample. Nonetheless, significant difference could be seen in lateral incisors' crown width of both females and males, which lied in the range of 6.87 mm to 7.67 mm wherein males on an average had a higher crown width. Our results also demonstrated a slightly wider range versus the Caucasian population, which lied in the range of 7.07 mm to 7.38 mm [14]. Based on the result, we can preliminarily say that the Malay population's upper anterior teeth are mostly of thin biotype, which is supported by the findings of Lee et al. [15] and Lee at al. [16]. In both groups, the main population was Chinese, which is different from our study wherein Malay population is the main group. This suggests that similar biotype may be applicable for both Malay and Chinese population. As per Bhat and Shetty [17] the maxillary central incisors' biotype spread for Indian adults who were aged 18-30 years were found to be prominently be that of the thick biotype. Their study was analogous to De Rouck et al. [3] who studied the adult population (predominantly Caucasian) in Brussels demonstrating the maxillary central incisors to be predominantly thick biotypes. Thus, it can be said that in western and Indian continent, the thick biotype is more predominant, while in South East Asia, thin biotype is more prominent. However, in this study, no significant differences were observed with regards to the biotype makeup between Malay females and males. These findings differ from the studies carried out by [18, 19] and [20] which demonstrated thinner masticatory mucosa associated with females in general.

Thin biotypes are in general more vulnerable towards labial plate fracture and need to be considered as precaution during extraction procedures [21]. Thus, patients with thin biotypes undergoing extraction need to be dealt with more care and precaution as they are prone to labial plate fracture. From a prosthodontic perspective, Nagaraj et al. [22] suggested supragingivally preparing for porcelain that is fixed to metal crown in order to prevent the shadow of the metal margins because of the translucency pertaining to the thin biotype. As per Ahmad [7], with regards to the aesthetic zone, all-ceramic crowns or ceramic implant abutment need to be employed in place of porcelain fused to metal crown in thin biotype. Also, gingival recession in thin biotypes could result due to over contoured restoration in place of forming pockets in thick biotypes. This has a high chance of resulting in aesthetic failure with regards to the restoration process.

Conclusion

To conclude, within the limits pertaining to the current study, by employing a simple method to evaluate gingival biotype, we showed that thin gingival biotype is associated with the majority of the Malaysian Malay population with regards to both lateral and central incisors. Therefore, a well-executed management plan needs to be carried out in treating patient with thin gingival biotypes to avoid dissatisfaction with the treatment outcome.

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