

Analysis Of The Relationship Between Facial Type And Gingival Phenotype

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Abstract

Background The width of attached gingiva depends on the height of the alveolar process and lower vertical dimension of the face. The relationship between facial type and gingival phenotype may be extremely important in the orthodontic planning. This study analyzed the relationship between facial types and different types of tooth crowns with the characteristics of the gingival tissue.

Methods 90 maxillary central incisors of 45 individuals were evaluated, aged 15 to 35 years, of both genders. The analysis addressed the width and thickness of keratinized gingiva (gingival phenotype) and dimensions of tooth crowns. The individuals were scored according to the facial type. The relationship between width of keratinized gingiva and gingival phenotype was correlated to the facial type (brachyfacial, mesofacial or dolichofacial) and size and shape of maxillary central incisors. The results were statistically analyzed by the Spearman correlation test (to evaluate the relationship between shape of tooth crowns and gingival biotype) and Kruskal-Wallis (to analyze the influence of facial types on the gingival characteristics), both at a significance level of 5%.

Results There was correlation between the gingival width and crown shapes ($p=0.00$). There were no statistically significant differences between facial types and width of keratinized gingiva ($p=0.33$) and between facial types and thickness of keratinized gingiva ($p=0.09$).

Conclusions Within the limitations, we conclude that the facial types did not seem to influence the gingival phenotype; however, the crown shapes seemed to be related to the quantity of keratinized gingiva.

Background

The homeostasis of the periodontium is directly related to the marginal tissue, which plays the roles of clinical attachment, resistance and dissipation of masticatory forces¹⁻². According to Bowers³ (1963), the dimension of the keratinized gingiva ranges from 1 mm to 9 mm and may be related to tooth positioning, muscle attachments and gingival recessions³.

The width of keratinized gingiva presents intra- and inter-individual variations, which are genetically determined and/or influenced by the tooth size, profile and positioning. It is wider at the incisor region, gradually decreasing in posterior direction, exhibiting minimum quantity at the premolar regions⁴. The width of attached gingiva depends on the height of the alveolar process and lower vertical dimension of the face, being wider in males⁶.

A minimum width of keratinized gingiva aims to maintain periodontal health maintenance. Lang & Löe² (1972) advocated a minimum width of 2 mm of keratinized gingiva, being 1 mm of attached gingiva, which would be fundamental for the gingival health. Currently it is considered that in favorable conditions, i.e. minimum plaque accumulation and traumatogenic factors, a width of keratinized gingiva smaller than 2 mm may be compatible with periodontal health. Based on the assumption that 1 or 2 mm

of keratinized gingiva may be sufficient in healthy conditions, pre-established concepts on the numerical width in millimeters that would be functionally adequate should be avoided⁷⁻¹¹.

Studies conducted after the 1990s have classified the soft tissue according to the phenotype (thickness), in general, as thin (≤ 1 mm) and thick (> 1 mm)^{4,12-14}. A greater thickness of keratinized gingiva has been considered more important than the width to reduce the risk of gingival recession in cases of orthodontic treatment¹⁵.

The gingival phenotype is a variable that should be clinically considered concerning the tissue response to aggressors. A thick gingiva responds more predictably to the restorative treatment, yet a great quantity of fibrotic tissue may respond to periodontal disease with the formation of pockets and infrabony defects. Conversely, the thin gingiva is friable and thus may respond with gingival recessions¹⁶.

It has been reported that tooth crowns with visibly distinct shapes present different periodontal morphologic characteristics. The maxillary central incisors indicate the periodontal phenotype; namely, elongated and narrow shapes have been associated with a smaller width of keratinized gingiva, while wide and short shapes determined the presence of greater quantity of keratinized gingiva, even though no differences have been found in the gingival thickness between these different types of crowns¹²⁻¹³.

It is also important to classify the individuals according to their facial characteristics and evaluate their relationship with the gingival tissue. There are several types of classification, as proposed by Angle, who divided the individuals according to the sagittal molar relationship into Class I, II or III; or by Andrews, who complemented the Angle classification without altering its basis. In the present study, the individuals were classified according to their facial type into mesofacial, dolichofacial or brachyfacial¹⁷.

The relationship between the gingival phenotype and the facial type may be extremely important in the orthodontic planning. This study evaluated the correlation between size and shape of maxillary central incisors with the width and gingiva phenotype; and the width and gingiva phenotype with the facial type.

Methods

The patients were informed on the evaluation to which they would be submitted and signed an informed consent form. The study was reviewed and approved by the Institutional Review Board of Hospital for Rehabilitation of Craniofacial Anomalies, University of São Paulo (n°146/2009).

The sample was composed of maxillary central incisors of 45 individuals aged 15 to 35 years, both genders. The individuals were divided into three groups according to their facial type, i.e. brachyfacial, mesofacial and dolichofacial.

According to the selection criteria, all subjects included in the sample presented clinically healthy periodontal tissues, with probing depth smaller than 3 mm, without visible signs of inflammation or history of previous periodontal disease, submitted or not to orthodontic treatment. The facial type was

classified by an experienced orthodontist, with the aid of cephalograms and clinical analysis in frontal and lateral views.

The anamnesis performed during clinical examination collected the following information on each patient: (1) age; (2) gender; (3) medical history; (4) probing depth, quantity and quality of keratinized gingiva; (5) facial type (brachyfacial, mesofacial, dolichofacial).

The following clinical parameters were evaluated:

a.

a) Probing depth of the gingival sulcus: measured from the gingival margin to the base of the gingival sulcus. This parameter was analyzed on the center of the buccal aspect to localize the attached gingiva, and the quality width of keratinized gingiva was evaluated at 2 mm apically. These measurements were obtained using a millimeter periodontal probe (Hu – friedy, USA).

b.

b) Width of keratinized gingiva: measured from the gingival margin to the mucogingival junction in millimeters, using a periodontal probe positioned horizontally to the tooth on the bottom of the buccal sulcus, pulling the alveolar mucosa in coronal direction, demarcating the mucogingival junction (Fig. 1).

c.

c) Gingival phenotype (thickness)

This was measured after local anesthesia, by introducing the tip of an anesthetic needle (2 mm apically to the probing depth measured) with a rubber stop perpendicular to the long axis of maxillary central incisors on the median aspect. The distance from the tip of the anesthetic needle to the rubber stop was measured with a digital pachymeter (Digemess, Brazil)¹⁴ (Figs. 2a and 2b).

d) Evaluation of the size and shape of maxillary central incisors

The teeth were measured directly in the mouth of each individual using a millimeter periodontal probe (Hu – friedy, USA), as follows:

- Crown extent (EC): measured from the most apical point of the gingival margin or cemento-enamel junction to the incisal tip.

- Crown width (WC): calculated from the greatest mesiodistal dimension.

To determine the size and overall shape of the tooth, the ratio between the crown extent (EC) and width (WC) was calculated. If the EC/WC ratio was smaller than, equal or close to 1 it would indicate a short and wide crown, while values greater than 1 would correspond to a long and narrow crown.

The clinical data were evaluated using the following tests: I – Spearman correlation test, to analyze the relationship between crown shape and width and thickness of keratinized gingiva; II – Kruskal-Wallis test, to analyze the influence of facial types on the gingival biotype, both at a significance level of 5%.

Results

The sample was composed of 90 maxillary central incisors of 45 individuals aged 15 to 35 years, being 33 females and 12 males. The individuals were divided into three groups according to their facial type, i.e. 15 brachyfacial, 15 mesofacial and 15 dolichofacial.

The mean, median, standard deviation (SD), minimum and maximum values of width of keratinized gingiva (in mm) and the Kruskal-Wallis test (KW) for comparison with the different facial types are presented in Table 1.

Table 1
– Comparison of keratinized gingival width of central incisors and facial types

Facial type	N	Mean	SD	Median	KW p
Brachyfacial	30	4.67	1.06	5.00	2.20 0.33 ^{ns}
Mesofacial	30	5.00	1.39	5.00	
Dolichofacial	30	5.27	1.44	5.00	
^{ns} – non-statistically significant difference					
There were no statistically significant differences between facial types and width of keratinized gingiva (p = 0.33).					
The mean, median, standard deviation, minimum and maximum values of thickness of keratinized gingiva (in mm) and the Kruskal-Wallis test for comparison with different facial types are demonstrated in Table 2.					

Table 2
– Comparison of keratinized gingiva width of central incisors and facial types

Facial type	N	Mean	SD	Median	KW p
Brachyfacial	30	1.74	0.19	1.76	4.76 0.09 ^{ns}
Mesofacial	30	1.65	0.31	1.60	
Dolichofacial	30	1.82	0.40	1.75	
^{ns} – non-statistically significant difference					
There were no statistically significant differences in the relationship between facial types and thickness of keratinized gingiva ($p = 0.09$).					
The graph below presents all values obtained in the relationship between extent and width of maxillary central incisors (EC/WC) and the respective measurements of width of keratinized gingiva obtained (Fig. 3).					
There was a tendency of increase in the width of keratinized gingiva with the decrease in the EC/WC ratio, i.e. the smaller and wider the tooth crown, the greater will be the quantity of gingiva. This tendency was confirmed by the Spearman correlation test, which revealed a value of $r = -0.32$ ($p = 0.00$), thus demonstrating significant correlation.					
The values obtained in the relationship between extent and width of maxillary central incisors (EC/WC) and the respective measurements of thickness of keratinized gingiva are presented in Fig. 4.					
There was no tendency of variation in the thickness of keratinized gingiva with changes in the EC/WC ratio according to the Spearman correlation test, revealing a value of $r = -0.17$ ($p = 0.11$), thus not demonstrating significant correlation between these variables.					

Discussion

Even though some studies in the literature have related the gingival phenotype with the gender and age, there have been scarce discussions on the possible correlation between the gingival biotype and facial patterns and/or types. Analysis of this relationship is very important for the clinical practice, since the facial type determines the tooth movement that may be safely performed without causing harmful effects on the investing and supporting periodontium.

The thin gingival phenotypes have been associated with longer dental crowns and thin gingival biotypes usually present shorter clinical crowns heights¹⁴. According to some authors, the buccal cortical bone thickness may be influenced by the facial type¹⁸, which may have some influence on the gingival phenotype, since tooth movement into a different position than that genetically determined in the alveolar process might represent a risk factor to the development of mucogingival disorders, especially in areas with thin bone and gingival tissue. Thus, the movement may cause bone dehiscence, which in turn may be a risk factor to the development of gingival recessions¹⁸.

In the present study, no significant differences were found in the gingiva phenotype when the three groups were compared, similar to the report of Alzoubi et al.¹⁹ (2008).

Concerning the possible relationship between size and shape of central incisors with the gingival phenotype, a correlation was observed with width of keratinized gingiva; namely, the smaller and wider the crown, the wider was this type of gingiva. However, no significant correlation was found between the crown shape and gingival phenotype. Olsson and Lindhe¹² (1991) reported that teeth with thin and long crowns presented greater tendency to gingival recession compared to teeth with smaller and wider crowns, however the authors did not correlate the shape of incisors and the gingival phenotype. A possible factor that may have influenced the study outcomes of their study was the inclusion of individuals with previous history of periodontal disease, because changes in the quality and quantity of gingiva and in tooth size may have been caused by the disease, which might hardly be extrapolated to individuals without periodontal disease. Since the gingival thickness was not measured, the width was considered more important than the gingival phenotype in the prevention of gingival recession. However, this is not an absolute conclusion, since some authors consider the thickness more important to prevent this disorder^{15,16}.

The gingival quality should also be considered in the periodontal homeostasis. However, most studies have evaluated only the influence of the width of keratinized gingiva. Lang & Löe² (1979) assumed that at least 2 mm of keratinized gingiva would be necessary, being 1 mm of attached gingiva. Other studies have questioned this minimum quantity of gingiva for periodontal health maintenance^{7,8,11}, yet no studies have evaluated the role played by tissue quality.

The gingival thickness may be associated to the tooth type, width of keratinized gingiva and probing depth. In the present study, the mean thickness of keratinized gingiva (in all facial types) was similar to the mean values described in the literature, ranging from 0.30 to 2.30 mm, corresponding to a tissue without clinical signs of inflammation, yet it was associated with the gingival phenotype and crown shape of maxillary incisors.

When individuals in the three developmental periods were compared (deciduous, mixed and permanent dentitions), the age had an influence on the width of keratinized gingiva, which tends to increase with age²⁰. Changes in the gingival thickness may also be related with age, with thicker gingival tissues in younger individuals and thinner tissues in the older²¹. Therefore, the thickness and width of keratinized gingiva are not always directly proportional, confirming the existence of more than two periodontal phenotypes. Also, according to Vandana and Savitha²¹ (2005), the gingival tissue is also usually thinner in females compared to the males.

Further studies are necessary to allow a better understanding on the role played by facial patterns using other classification systems, crown shape considering different teeth, as well as their relationship with age and gender.

Conclusions

We conclude that the facial type did not seem to influence the gingival phenotype of individuals and that the size and shape of maxillary central incisors did not seem to influence the thickness of keratinized gingiva, yet there seemed to be a relationship with the width, since the smaller and wider the tooth crown, the greater would be the width of keratinized gingiva.

Abbreviations

%

Percentage

mm

millimeter

EC

Crown Extent

CW

Crown Width

SD

Standard Deviation

KW

Kruskal-Wallis

Declarations

Availability of data and materials

The databases generated during and analyses during the current study are available from the corresponding author on reasonable request.

Authors contribution

ALPFA was responsible for the study design and critical review of the manuscript. LC, PHHJ, NRF and VEAG were responsible to acquisition of data and for drafting of the manuscript. All authors have read and approved the manuscript.

Ethics Approval and Consent to Participants

The patients were informed on the evaluation to which they would be submitted and signed an informed consent form. Patients under 18 years old signed an acquiescence form after their parent or guardian

singed the consent form. The study was reviewed and approved by the Institutional Review Board of Hospital for Rehabilitation of Craniofacial Anomalies, University of São Paulo (n°146/2009).

Consent for publication

The images that were included in this paper are from one of the authors

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Competing interest

The authors declare that they have no competing interest

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Figures



Figure 1

Determination of the quantity of keratinized gingiva (Bowers method)

Fig. 2

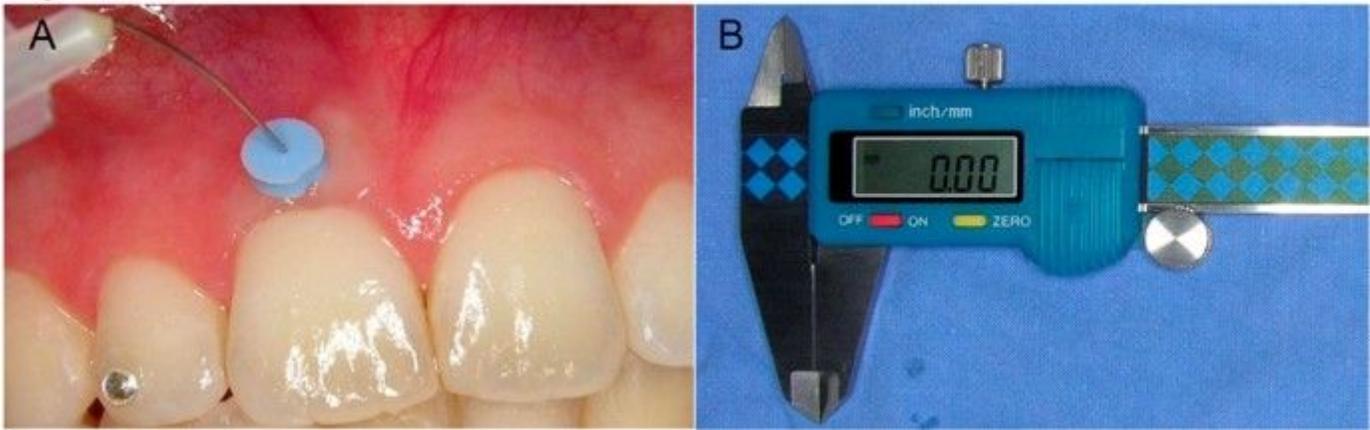


Figure 2

a) Measurement of gingival thickness; b) Digital pachymeter used to measure the gingival thickness.

Fig. 3

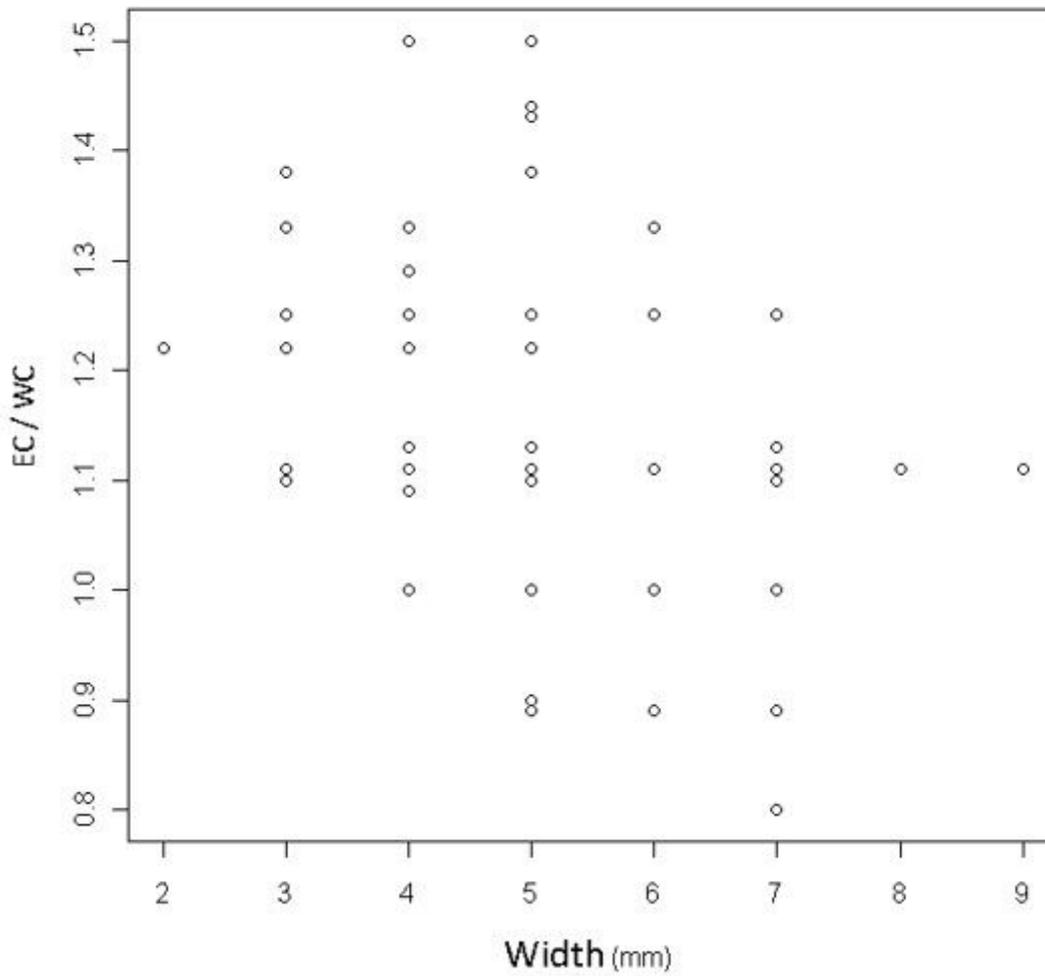


Figure 3

