Association between gingival tissue biotype and different facial phenotypes

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Abstract Objective: This study was conducted to investigate the association between gingival tissue biotypes and different facial phenotypes.

Method: This was a cross-sectional study conducted in the dental clinics of Riyadh Elm University, Riyadh, Saudi Arabia. Gingival tissue biotypes were assessed and facial measurements recorded for 80 subjects who met the inclusion criteria. Data are presented as numbers (percentages) for all categorical variables and mean ± standard deviation plus median (interquartile range) for all continuous variables. Both descriptive and inferential statistics were analyzed and a P-value ≤ 0.05 was accepted as significant for all statistical tests.

Results: The age range of the participants was 21–40 years (mean 28.8 ± 04.3), and the majority were males (65.0%). The thin gingival tissue biotype was found in 39 subjects (48.8%) while the thick gingival biotype was present in 41 subjects (51.2%). The majority of patients were mesoprosopic (41.2%), followed by those who were leptoprosopic (35.7%) and euryprosopic (21.3%). The thick gingival tissue biotype was more prevalent in 21–30-year-old patients. The mesoprosopic facial phenotype was significantly associated with presence of the thin gingival tissue biotype (odds ratio = 3.600, p = 0.049).

Conclusions: It was found that the mesoprosopic facial phenotype was more likely to exhibit the thin gingival tissue biotype. The mesoprosopic facial phenotype was the most common facial phenotype of the subjects. The thick gingival tissue biotype was more prevalent in younger people. © 2019 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Periodontal health is defined as the absence of inflammatory reactions that involve periodontal tissues accompanied with either gingivitis or periodontitis, and is based on a clinical evaluation (Lang and Bartold, 2018). The protection and maintenance of periodontal health are suggested to be related to the presence of an adequate zone of keratinized gingiva (Bouri et al., 2008).
A clinically healthy periodontium has been shown to have a varied phenotypic appearance that differs between individuals. The scalloped and the flat gingival architecture are described as the two main forms of the gingival biotype (Olshenbein and Ross, 1969). The thin-scalloped biotype has been seen mainly in teeth that have a narrow-tapered crown form, slight cervical convexities, and small contact areas that are located close to the incisal edge of the teeth. The thick-flat biotype has been observed in individuals who have teeth with a short but wide crown, obvious cervical convexities, and broad contact areas positioned more apically (Weisgold, 1977; Seibert and Lindhe, 1989).

Evaluation of the periodontal biotype is regarded as an essential part of treatment planning for several dental treatments including periodontal, restorative, orthodontic, and implant treatment. Outcomes of various treatments can be affected by the thickness of the gingival tissue and underlying bony structure (Zweers et al., 2014).

The human face, the most noticeable part of the human body, expresses information about an individual’s age, sex, ethnicity, and health. During ontogenesis, the facial features undergo marked changes in size and shape, which are mostly associated with the growth and development of underlying bone structures (Jandová and Urbanová, 2016). On the basis of the facial index, the facial phenotype can be classified as the hypereuryprosopic, euryprosopic, mesoprosopic, leptoprosopic, or hyperleptoprosopic face shape (Williams, 1995).

Information about the correlation between periodontal parameters of different facial types is lacking since few related studies have been published. In an 11-year follow-up retrospective study involving 556 subjects who met the study inclusion criteria involving gingival recession, and clinical attachment loss were significantly associated with patients who exhibited a phenotype of a long narrow face (Salti et al., 2017). Our study aimed to investigate the association between gingival tissue biotypes and different facial phenotypes.

2. Material and methods

2.1. Study design and sampling

- This was a cross-sectional study. The subjects participating in this study were Riyadh Elm University interns and postgraduate students. The sample population was set at 80 subjects after being weighted and calculated by a statistician using G-Power test software.

2.2. Participants’ inclusion criteria

- Saudi
- Aged between 20 and 45 years
- Mentally competent
- Presence of permanent teeth in the anterior maxilla from 13 to 23 (maxillary right canine to maxillary left canine)
- Healthy gingiva on the mid-buccal site from 13 to 23.

2.3. Participants’ exclusion criteria

- Subjects with a prosthesis or restoration involving the gingival margin of maxillary anterior teeth from 13 to 23
- Pregnant or lactating women
- Having pockets exceeding 3 mm
- History of orthodontic treatment
- Plaque-induced and drug-induced gingival enlargement
- Previous surgical therapy at the sites measured (including connective tissue grafts and periodontal surgeries)
- Smoker

2.4. Clinical protocol

2.4.1. Gingival tissue biotype evaluation:

- The probe visibility assessment method was used to assess gingival tissue biotype.
- For all teeth included in the study, a University of North Carolina-15 (UNC-15) periodontal probe was inserted into the mid-facial gingival sulcus.
- Gingival biotype was categorized as follows:
  - Thin tissue biotype when the UNC probe was seen through mid-facial gingival sulcus.
  - Thick tissue biotype when the UNC probe could not be seen through mid-facial gingival sulcus. (Kan et al., 2010)

2.4.2. Facial phenotype evaluation:

- Each subject was seated in a dental chair with the head upright, which was supported by a headrest.
- Facial measurements were recorded by using a digital spreading caliper.
- Morphological facial height was measured from the Nasion landmark, which resembles the intersection of the nasofrontal suture with the midsagittal plane landmark to the Gnathion landmark, the most anterior and lowest median point on the border of the mandible.
- Facial width, also known as the bizygomatic breadth, was measured from the right zygion to the left zygion.
- The prosopic (facial) index was calculated using the following formula:

\[
\text{Prosopic (facial) index} = \frac{\text{facial height (nasion to gnathion)}}{\text{zygomatic breadth(zygion to zygion)}} 
\]

- The facial phenotypes were classified as follows:
  - Euryprosopic (brachyfacial): Low and wide face; prosopic index of 84.9 or less.
  - Mesoprosopic (mesofacial): Face neither wide nor narrow (average); prosopic index ranges from 85.0 to 89.9.
  - Leptoprosopic (dolichofacial): High and narrow face; prosopic index of 90 or more. (Williams, 1995)

2.5. Statistical methods

SPSS version 21 (IBM Corp., Armonk, NY, USA) was used to perform all statistical analyses for this project. Data are shown...
as numbers (percentages) for all categorical variables and mean ± standard deviation plus median (interquartile range) for all continuous variables. Both descriptive and inferential statistics were analyzed.

A P-value ≤ 0.05 was accepted as the level of significance for all statistical tests. Associations between the dependent variable and the independent factors were calculated using the chi-square test. Additionally, binary logistics regression was used to predict the likelihood ratio between the dependent variable and the independent variables, where the odds ratio as well as a 95% confidence interval were calculated.

Normality, statistical interactions, and collinearity (i.e., variance inflation factor) were also assessed. We used the Kolmogorov-Smirnov and Shapiro–Wilk test to evaluate the distribution of the quantitative data. All continuous variables included in the statistical tests were found to be normally distributed.

3. Results

- A total of 80 patients were recruited in this study. The age range was from 21 to 40 years (mean 28.8 ± 04.3), of whom the majority were males (65.0%). The prevalence of the thin gingival tissue biotype was 48.8% (39 patients), while that of the thick gingival biotype was 51.2% (41 patients) (Fig. 1). With regard to facial phenotypes, 33 (41.2%) of them were mesoprosopistic, 30 (37.5%) were leptoprosopistic, and 17 (21.3%) were euryprosopistic (Fig. 2).

Mean facial height of the patients was 107.8 mm (SD ± 05.9) while the mean facial width was 122.1 mm (SD ± 06.2). The mean facial index was 88.4 mm (SD ± 04.4) (Table 1).

The chi-square test as well as an independent t-test were used to measure the association between gingival tissue biotype against the baseline characteristics of patients with p-values, which indicate whether an association is statistically significant. Thick gingival tissue was more prevalent in 21–30-year-old patients Table 2.

The thin gingival biotype was found in 66.7% of males and 33.3% of females. The thick gingival biotype was found in 63.4% of males and 36.6% of females.

Regarding facial phenotypes, the number and percentage of patients with the thin gingival biotype were as follows: 5 (12.8%) for the euryprosopistic, 16 (41.0%) for the mesoprosopistic and 18 (46.2%) for the leptoprosopistic phenotype. The thick gingival biotype was found in 12 cases (29.3%) for the euryprosopistic, 17 cases (41.5%) for the mesoprosopistic, and in 12 cases (29.3%) for the leptoprosopistic phenotype.

Mean facial height for patients with the thin gingival biotype was 106.9 mm while for patients with the thick gingival biotype, it was 108.5 mm. Mean facial width for patients with the thin gingival biotype was 120.2 mm while for the thick biotype patients it was 123.9 mm. The resultant facial index for the thin gingival biotype patients was 89.1 ± 03.9 while for cases with the thick biotype it was 87.7 ± 04.7.

It was revealed that among all the variables included in the test, only facial width was found to have a significant association with the gingival tissue biotype (p = 0.006). Other baseline characteristics did not show a significant association (Table 2).

Binary logistics regression analysis was conducted to ascertain the effect of the thin gingival tissue on the baseline characteristics of participants. Regression factors such as age group in years, gender, facial phenotype, facial height, facial width, and facial index were included in the model. Based on the results, it

![Gingival Tissue](image1)

![Facial Phenotype](image2)

![Table 1 Baseline characteristics of patients.](image3)
Table 2: Association between the gingival tissue and the baseline characteristics of patients.

| Factor           | Gingival tissue biotype (n=80) | P-value |
|------------------|-------------------------------|---------|
|                  | Thin (n=39) (%) | Thick (n=41) (%) |         |
| Age group in yearsa |                  |                  |         |
| ≤ 30 years old   | 23 (59.0%) | 31 (75.6%) | 0.112 |
| > 30 years old   | 16 (41.0%) | 10 (24.4%) |         |
| Gendera          |                  |                  |         |
| Male             | 26 (66.7%) | 26 (63.4%) | 0.761 |
| Female           | 13 (33.3%) | 15 (36.6%) |         |
| Facial Phenotypea |                  |                  |         |
| Leptoprosopic    | 05 (12.8%) | 12 (29.3%) | 0.131 |
| Mesoprosopic     | 16 (41.0%) | 17 (41.5%) |         |
| Euryprosopic     | 18 (46.2%) | 12 (29.3%) |         |
| Mean ± SD        | 106.9 ± 05.7 | 108.5 ± 06.2 | 0.245 |

* P-value has been calculated using the chi-square test.
* P-value has been calculated using an independent t-test.
** Significant at p ≤ 0.05 level.

is clear that mesoprosopic had a statistically significant association with the thin gingival tissue (OR = 3.600, p = 0.049), and it can be interpreted that mesoprosopic facial phenotype was more likely to exhibit a thin gingival tissue biotype than the euryprosopic phenotype. Increasing facial width was associated with an increased likelihood of exhibiting thin gingival tissue (OR = 1.115, p = 0.009), while age group in years, gender, facial height, and facial index were found to be non-significant factors of thin gingival tissue presence (Table 3).

4. Discussion

In the present study, the prevalence of the thin gingival tissue biotype was nearly half of the total sample population (48.8%). This is consistent with the study published by Zawawi, Al-Harthi, and Al-Zahrani, 2012 in Saudi Arabia, which was about the prevalence of gingival biotype and its relationship with dental malocclusion. They reported that 44.5% of 200 patients were of the thin gingival biotype.

Several studies published in other countries have also reported the prevalence of the thin gingival tissue biotype. In Italy, Aimetti et al., 2008 observed that 45% of patients in their study were of the thin gingival biotype, which was marginally higher than that observed in our study, while in Syria, a lower incidence (41.6%) of the thin gingival biotype was reported (Barakat and Dayoub, 2016).

In contrast, prevalence of the thick gingival tissue biotype in this study was 51.2%, which is moderately lower than those reported in previously published articles (Zawawi, Al-harthi, and Al-zahrani, 2012; Aimetti et al., 2008; Barakat and Dayoub, 2016). Our findings were in agreement with a study published locally (Zawawi et al., 2012). They reported a prevalence of 55.5% for the thick gingival tissue biotype, which is closer to our study results. Barakat and Dayoub, 2016, observed the highest prevalence (58.4%) of the thick gingival tissue biotype.

In the present study, the majority of the young males had the thick gingival tissue biotype while the older males and the females, in general, were more likely to have the thin gingival biotype. A higher prevalence of the thick gingival tissue biotype in males has been reported by various published articles (Zawawi, Al-harthi, and Al-zahrani, 2012; Bhat and Shetty, 2013; Abraham, 2015).

The present study focused on measuring the association between gingival tissue biotypes and facial morphology phenotypes. To our knowledge, this is the first study that has evaluated these relationships. Based on the evaluation of the independent variables, including age, gender, facial height, facial width, facial index, and facial phenotype, it was revealed that facial width and the mesoprosopic facial phenotype had a significant association (Table 3).

However, based on the likelihood ratio, the mesoprosopic phenotype was significantly associated with the thin gingival tissue biotype, and patients with this phenotype were three times more likely to exhibit a thin gingival tissue biotype than those with the euryprosopic phenotype (OR = 3.600, p = 0.049). This may be explained by the findings of Masumoto et al., (2001), which revealed that the average face (mesoprosopic) phenotype was less commonly associated with alveolar bone thickness than the short, broad face (euryprosopic) phenotype. Subsequently, it has been demonstrated based on a CBCT evaluation study that the thin gingival tissue biotype was associated with thinner alveolar bone thickness (Fu et al., 2010).

The present study revealed that greater facial widths were associated with an increased likelihood of exhibiting the thin gingival tissue biotype (OR = 1.115, p=0.009). In contrast, no significant relationship was found between facial width and the periodontal parameters, including attachment loss.

Table 3: Regression analysis to ascertain the influence of thin gingival tissue from the baseline characteristics of patients (n=80).

| Factor          | OR   | 95% CI       | P-value |
|-----------------|------|--------------|---------|
| Age group in yearsa |      |              |         |
| ≤ 30 years old  | 2.157| 0.828–5.613  | 0.115   |
| > 30 years old  | 3.600| 1.007–12.865 | 0.049** |
| Gender          |      |              |         |
| Male            | 0.867| 0.345–2.176  | 0.761   |
| Female          |      |              |         |
| Facial Phenotype |      |              |         |
| Leptoprosopic   | 1.594| 0.586–4.331  | 0.361   |
| Mesoprosopic    | 0.925| 0.833–1.027  | 0.143   |
| Euryprosopic    | 1.115| 1.027–1.210  | 0.009** |

OR – Odds ratio
CI – Confidence interval.
** Significant at the p ≤ 0.05 level.
and gingival recession, which were also evaluated by (Salti et al., 2017).

In this study, no significant relationship was found between the age group in years, gender, facial height, and facial index, and the thin gingival tissue biotype. Conversely, Abraham, 2015 found a significant association between this biotype and gender and age. The thicker gingival biotype was more prevalent in male subjects while female subjects presented more commonly with the thin gingival biotype. The thick gingival biotype was observed in the young age group, while the thin biotype was more common in older subjects. In Malaysia, it was observed that with increasing age, gingival thickness tended to be reduced in both the maxillary and mandibular jaws (Agarwal et al., 2017).

5. Conclusions

The following conclusions can be drawn from the present study:

- The mesoprosopic facial phenotype and facial width have a significant association with the thin gingival tissue biotype.
- The mesoprosopic facial phenotype was the most common facial phenotype.
- The thick gingival tissue biotype was more prevalent in younger people and in males.

6. Ethical

The IRB approval number is RC/IRB/2018/1250.

Conflict of interest

The author declares that there was no external source of funding for the present study.

References

Abraham, S., 2015. Correlation of gingival tissue biotypes with age, gender and tooth morphology: a cross sectional study using probe transparency method. IOSR J. Dent. Med. Sci. 14, 64–69. https://doi.org/10.9790/0853-14956469.

Agarwal, V., Mehrotra, N., Vijay, V., 2017. Gingival biotype assessment: variations in gingival thickness with regard to age, gender, and arch location. Indian J. Dent. Sci. 9, 12.

Aimetti, M., Massei, G., Morra, M., Cardesi, D.M.D.E., Romano, F., 2008. Correlation between gingival phenotype and Schneiderian membrane thickness. Int. J. Oral Maxillofac. Implants 23, 2–7.

Barakat, H., Dayoub, S., 2016. Prevalence of gingival biotype in a syrian population and its relation to tooth shapes: a cross-sectional study. J. Biomed. Sci. Eng. 9 (141–146), 141–146.

Bhat, V., Shetty, S., 2013. Prevalence of different gingival biotypes in individuals with varying forms of maxillary central incisors: a survey. J. Dent. Implant. 3, 116.

Bouri, A., Bissada, N., Al-Zahrani, M.S., Faddoul, F., Nouneh, I., 2008. Width of keratinized gingiva and the health status of the supporting tissues around dental implants. Int. J. Oral Maxillofac. Implants 23, 323–326.

Fu, J.-H., Yeh, C.-Y., Chan, H.-L., Tatarakis, N., Leong, D.J.M., Wang, H.-L., 2010. Tissue biotype and its relation to the underlying bone morphology. J. Periodontol. 81, 569–574. https://doi.org/10.1902/jop.2009.090591.

Jandová, M., Urbanová, P., 2016. The relationship between facial morphology, body measurements and socio-economic factors. Anthropol. Rev. 79, 181–200. https://doi.org/10.1515/anre-2016-0014.

Kan, J.Y., Morimoto, T., Rungcharassaeng, K., Roe, P., Smith, D.H., 2010. Gingival biotype assessment in the esthetic zone: visual versus direct measurement. Int J Periodontics Restor. Dent 30, 237–243.

Lang, N.P., Bartold, P.M., 2018. Periodontal health. J. Periodontol. 89, S9–S16. https://doi.org/10.1002/jper.16-0517.

Masumoto, T., Hayashi, I., Kawamura, A., Tanaka, K., Kasai, K., 2001. Relationships among facial type, buccolingual molar inclination, and cortical bone thickness of the mandible. Eur. J. Orthod. 23, 15–23. https://doi.org/10.1093/ejo/23.1.15.

Ochsenbein, C., Ross, S., 1969. A reevaluation of osseous surgery. Dent. Clin. North Am. 13, 87.

Salti, L., Holtfreter, B., Pink, C., Habes, M., Biffar, R., Kiliaridis, S., Krey, K., Bülow, R., Völzke, H., Kocher, T., 2017. Estimating effects of craniofacial morphology on gingival recession and clinical attachment loss. J. Clin. Periodontol. 44, 363–371.

Seibert, J., Lindhe, J., 1989. Esthetics and periodontal therapy. Textb. Clin. Periodontol., 2nd ed. Copenhagen, Denmark Munksgaard, pp. 477–514.

Weisgold, A.S., 1977. Contours of the full crown restoration. Alpha Omega 70, 77–89.

Williams, P., 1995. T, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MWJ: Gray’s Anatomy. Churchill Livingstone.

Zawawi, K.H., Al-harthi, S.M., Al-zahrani, M.S., 2012. Prevalence of gingival biotype and its relationship to dental malocclusion. Saudi Med. J. 33, 671–675.

Zweers, J., Thomas, R.Z., Slot, D.E., Weisgold, A.S., Van Der Weijden, F.G.A., 2014. Characteristics of periodontal biotype, its dimensions, associations and prevalence; a systematic review. J. Clin. Periodontol. 41, 958–971. https://doi.org/10.1111/jcpe.12275.