Influence of periodontal biotype on the presence of interdental papillae

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The absence of interdental papillae can be a negative influence in aesthetics. Periodontal biotype (PB) is one of the factors that can possibly influence this relation and has to be considered in periodontal diagnosis and treatment planning. The objective of this study was to evaluate the influence of the periodontal biotype on the presence and absence of interdental papillae. Forty-seven patients were included in this transversal clinical study. The PB, presence and height of interdental papilla, loss of papillary height, and the distance between the base of the contact point and bone crest (CP-BC) were evaluated. The chi-square test was used to verify the significance level of the PB distribution frequency between groups. The Mann-Whitney test was used to compare the CP-BC measures between the different PB groups, and the correlation test was used to verify the relation between the CP-BC distance and the presence of papillae. The thin PB group presented a significantly higher presence of papillae (71.1%) than did the thick PB group (59.6%, \( P < 0.05 \)). An inverse and proportional correlation between the CP-BC distance and the presence of papillae was found. The authors concluded that the PB influenced the presence and height of interdental papillae.

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The number of patients seeking esthetic periodontal treatments, beyond the treatment of the bacterial component of periodontal disease, has increased over the past decades. One of the factors involved in this esthetic demand is the presence of an intact and harmonious gingival contour.\(^1,2\)

Interdental papillae (also known as gingival papillae) occupy the space between adjacent teeth. Morphologically, the papillae were described first in 1959.\(^3\)

Before this time, an interdental papilla’s sole function was to deflect interproximal food debris. Now it is understood that the physiology of the papilla is more complex. It not only acts as a biological barrier in protecting the periodontal structures, but also plays a critical role in the esthetics of teeth. Hence, it is very important to respect papilla integrity and minimize their removal during dental procedures as much as possible.\(^4\)

Today’s dentists face esthetic standards that require a soft-tissue contour, with intact papillae and a symmetrical gingival outline, especially in the interdental area of the maxillary central incisors (defined as the central papillae).\(^3\)

The presence of a space below these contact areas can lead to esthetic defects, speech impairment, and food impaction.\(^6\) Several efforts have been undertaken to treat and restore missing interproximal papillae. If the loss of a papilla is related to soft tissue damage only, reconstructive techniques are able to restore it completely. If the loss of an interdental papilla is caused by severe periodontal disease with interproximal bone resorption, complete reconstruction is generally not achieved.\(^7\) Different surgical and nonsurgical approaches are proposed in the periodontal literature to provide satisfactory interdental papillae reconstruction. Unfortunately, although more and more sophisticated approaches showing good clinical results have been proposed to restore the lost interdental papillae, the predictability of various procedures has not been completely documented, and no data on long-term success rates are available in the literature.\(^8\)

Therefore the probability of loss should be anticipated before treatment, and the
patient should be informed of the consequences of the loss of interdental papillae.

Aspects related to the periodontal biotype (PB) are frequently not considered during periodontal treatment planning. The relationship between PB and the presence or absence of interdental papillae is not well-documented. Thus, the aim of this study was to evaluate the influence of the PB on the presence and absence of interdental papillae.

**Materials and methods**

Forty-seven patients (21 male and 26 female), between the ages of 18 and 63 (mean 36 ± 11.14), were included in the present study.

The following inclusion criteria were used: presence of contact points between maxillary canines and incisors, and no interproximal and/or root surface restorations. The exclusion criteria were: a gingival index (GI) >1, smoking, transplantation, uncontrolled systemic disease, orthodontic treatment, and/or taking medication known to interfere with periodontal tissue health.

Each patient signed an informed consent after the risks and benefits of the associated procedures were explained. The study protocol was approved by the Veiga de Almeida University Ethical Committee under the number 100/08.

**Clinical parameters**

The following measurements were recorded by a single calibrated examiner: PB, presence of interdental papilla (PIP), loss of papillary height (LPH), distance between the base of the contact point and bone crest (CP-BC).

PB was visually classified as *thin* or *thick*, according to Kao & Pasquinelli (Fig. 1 and 2). When evaluating PIP, the papilla was considered present when there was no visible space apical to the contact point and LPH was identified using the system proposed by Nordland & Tarnow as follows: Normal – interdental interdental papilla fills the embrasure space to the apical extent of the interdental contact point/area; Class I – the tip of the interdental papilla lies between the interdental contact point and the most coronal extent of the interproximal cementoenamel junction (CEJ); Class II – the tip of the interdental papilla lies at or apical to the interproximal CEJ but coronal to the apical extent of the facial CEJ; Class III – the tip of the interdental papilla lies level with or apical to the facial CEJ (Fig. 3–6).

The CP-BC distance was measured using a 15 mm periodontal probe (Pcpunc, Hu-Friedy Mfg. Co., LLC) and approximated to the upper whole millimeter, if necessary (Fig. 7). A bilateral infraorbital nerve block was performed, using 2% lidocaine with epinephrine 1:100,000 (DFL Industria e Comercio). After 10 minutes, the area was dried for 30 seconds and the measurements were taken using a bone sounding technique. The probe was positioned as parallel as possible to the long axis of the tooth.

All papillae were grouped by PB and by tooth region: papillae between canines and premolars (CA/PM), papillae between lateral incisors and canines (LI/CA), papillae between central incisors and lateral incisors (CI/LI), papillae between central incisors (CI/CI).

**Statistical analysis**

The chi-square test was used to verify the significance level of the PB distribution between groups. The Mann-Whitney test was used to compare the CP-BC measures between the different PB groups. The correlation test was used to verify the relation between the CP-BC distance and the presence of a papilla.

**Results**

The thick PB was found in 25 patients (13 male and 12 female) and the thin PB was found in 22 patients (8 male and 14 female). Two hundred seventy-one papillae were evaluated (136 in the thick PB group and 135 in the thin PB group) (Table 1).

The PIP results showed that the thin PB group presented a significantly greater presence of papillae (71.1%) than did the thick PB group (59.6%, \( P < 0.05 \)). The thin PB group presented a significantly greater presence of papillae at the CA/
PM and LI/CA tooth regions (92.1% and 84.2%, respectively) than did the thick PB group (75.0% and 57.5%, respectively; \( P < 0.05 \)). In the CI-LI tooth region, there was a greater, but not significant, presence of papillae in both PB groups (\( P > 0.05 \)). While there was an increased absence of papillae found in the CI/CI tooth region, the results were not significant (Table 2).

The LPH classification showed that most papillae were classified as normal (65.3%). The thin PB group presented a higher number of normal papillae than did the thick PB group (71.1% and 59.6%, respectively, \( P < 0.05 \)). The Class I group was found to be significantly more numerous in the thick PB group (33.1% and 20.0%, respectively, \( P < 0.05 \)). There were no statistically significant differences between PB groups and tooth regions at a 5 mm CP-BC distance. At a 6 mm CP-BC distance, the thin PB had a greater presence of papillae (\( P < 0.05 \)). When the tooth regions were compared by PB, only the CA/PM showed a statistically significant difference between groups (\( P < 0.05 \)).

For the thick PB, the CP-BC measures were: CA/PM = 5.19 ± 1.04, LI/CA = 5.48 ± 1.04, CI/LI = 5.26 ± 1.90, and CI/CI = 6.41 ± 2.04.

The correlation analysis showed that there were no statistically significant differences between PB groups and tooth regions at a 5 mm CP-BC distance. At a 6 mm CP-BC distance, the thin PB had a greater presence of papillae (\( P < 0.05 \)). When the tooth regions were compared by PB, only the CA/PM showed a statistically significant difference between groups (\( P < 0.05 \)).

Table 2. Presence of interdental papillae (%) by periodontal biotype and tooth region.

<table>
<thead>
<tr>
<th></th>
<th>Thin PB</th>
<th>Thick PB</th>
</tr>
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<tbody>
<tr>
<td>Presence</td>
<td>Absence</td>
<td>Presence</td>
</tr>
<tr>
<td>CA/PM*</td>
<td>92.1</td>
<td>7.9</td>
</tr>
<tr>
<td>LI/CA*</td>
<td>84.2</td>
<td>15.8</td>
</tr>
<tr>
<td>CI/LI</td>
<td>53.8</td>
<td>46.2</td>
</tr>
<tr>
<td>CI/CI</td>
<td>40.0</td>
<td>60.0</td>
</tr>
</tbody>
</table>

* Statistically significant difference between PB groups (\( P < 0.05 \))

Abbreviations: PB, periodontal biotype; CA/PM, papillae between canines and premolars; LI/CA, papillae between lateral incisors and canines; CI/LI, papillae between central incisors and lateral incisors; CI/CI, papillae between central incisors.
The comparison between the 5 mm and 6 mm CP-BC distance showed that no significant differences were found in the thin PB. However, significant differences were found in the thick PB group, as the 5 mm group presented papillae in 77.5% of the sites and the 6 mm group presented papillae in 36.8% of the sites.

The tooth region analysis showed that there was a statistically significant difference between the 5 and 6 mm CP-BC distances only in the thick PB group at the CA/PM and LI/CA regions ($P < 0.05$).

The correlation test showed an inverse and proportional correlation between the CP-BC distance and the presence of papillae: as the CP-BC distance increased, the frequency of papillae decreased in both biotype groups (thin PB, $r = -0.90$; thick PB, $r = -0.92$).

Correlation tests were made between the CP-BC distance and the LPH. The Class I LPH was more frequent in the thick biotype group ($P < 0.05$). The Class II LPH had a constant frequency for all CP-BC distances, with an increase at the 7 mm distance in both PB groups. The Class III LPH was observed at a ≥7 mm CP-BC distance, with an increase in both groups at an 8 mm CP-BC distance (with a higher frequency in the thin PB group). The statistical analysis of these data was not performed because of the small number of sites (Chart 3).

### Discussion

This study aimed to evaluate if there is a correlation between PB and the presence or absence of interdental papilla. Current esthetic periodontal treatments are driven by the search for techniques where success is measured not only by the quality of postoperative symptoms, including the lack of scars, but also by the predictability of results. This requires the use of diagnostic methods to examine the surrounding tissues to determine periodontal defects and consider thoroughly the biologics of the involved gingiva. To this end, the PB determination is critical for professionals who perform procedures in the esthetic zone, since the identification of the periodontium could predict future periodontal defects, determine different manipulation strategies of the soft tissues, and help in correcting existing problems.

The present study used the classification proposed by Kao & Pasquinelli. However, a precise periodontium evaluation requires controlled trials to determine a thickness pattern, since most studies use clinical observations to classify the PB. Generally, a precise periodontium evaluation requires controlled trials to determine a thickness pattern, since most studies use clinical observations to classify the PB.10,11,16-18

Generally, the thicker periodontium is characterized by a fibrous, dense gingival tissue, and a wide band of keratinized tissue. The flat topography suggests a thick bony architecture. The thick bone/gingival pattern provides more resistance to tissue injury, and also allows for more predictable surgical procedures, resulting in less postoperative bone remodeling and gingival recession, which can help predict future tissue positioning. On the other hand, the thin periodontium is characterized by a delicate, friable gum, and a narrow strip of keratinized tissue. The topography is scalloped, suggesting a very thin bone, with possible areas of dehiscence and fenestrations. There is a greater tendency toward gingival recession.
The influence of the distance between the contact point and the bone crest in the presence of interdental papillae was investigated by Tarnow et al. Those authors observed that the presence of interdental papillae decreased with an increased CP-BC distance. The results of the present study also demonstrated this relationship. Nevertheless, most of the CP-BC distances in the present study ranged between 4 and 6 mm, while the range in the study by Tarnow et al was between 5 mm and 7 mm. Previous authors observed a 4.5 mm mean CP-BC distance in cadavers. In the present study, the mean CP-BC distance was 5.57 mm and 5.86 mm in the thin and thick PB groups, respectively.

The presence of interdental papillae in the current study was similar to previous results, with a greater presence of papilla for the ≤5 mm distances, but with different percentages, since the present study reported 88.9%, 92.7%, and 78.3% for distances of 3, 4, and 5 mm, respectively; other authors found the presence of interdental papillae at these distances to be 100%, 100%, and 98%, respectively.

The LPH analysis demonstrated that the presence of normal papillae was influenced by the CP-BC distance in both PB groups, with a positive and inversely proportional correlation, especially for the thin PB at a CP-BC distance of 6 mm. This can be related to the presence of elongated teeth in thin PBs, with coronal contact points, thereby increasing the CP-BC distance.

The presence of a Class I LPH was more frequent in the thick PB group for the 6 and 7 mm CP-BC distances. This could be explained by the observation that the CP-BC distance would interfere with the presence of papilla only at ≤3 mm distances, which is related to square teeth with wide roots, with the horizontal bone loss compromising the presence of papilla.

The Class II LPH at the 6 and 7 mm CP-BC distances was higher in the thin PB group. This could be related to the fact that severe bone loss can lead to papillary loss and formation of black spaces. The fibrotic configuration, square teeth, and an apical contact point of the thick BP can be responsible for maintaining the papilla contour in severe bone loss.

The Class III LPH was present only for >7 mm CP-BC distances, and was more prevalent in the thin PB group. Other reports observed the loss of papillary tissue in wide and long interproximal spaces, which are common in thin PB.

Differences in crown anatomy, root anatomy, and height of contact point can be related to the differences observed in the presence of papilla at the CA/PM and LI/CA sites between thin and thick PBs.

**Conclusion**

The PB influenced the presence of interdental papillae. The thick PB group presented a greater loss of papillary height, and the thin biotype group presented a greater frequency in the presence of papilla at a 6 mm CP-BC distance, as well as a greater loss of papillary height at small CP-BC distances. However, future studies are necessary to clarify the roles of other related factors, such as the distance between tooth roots, the shape of the teeth, root inclination, and the distance between the contact point and the bone crest.

The absence of normal interdental papillae affects gingival esthetics, and can be influenced by the PB, making it an important factor in the evaluation of a patient’s esthetics.

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**Manufacturers**

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