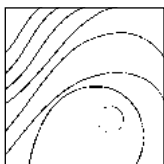


## Clinical and Radiographic Evaluation of Factors Influencing the Presence or Absence of Interproximal Gingival Papillae



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*This study evaluated factors that may influence the presence or absence of interproximal papillae. Clinical evaluation consisted of visual determination, and quantitative analyses were made using millimeter grids on radiographs. Patients (n = 45) were divided into three groups according to age. Data were analyzed using the chi-square test followed by the Student t test ( $\alpha = .05$ ). The distance from the contact point to the bone crest had significant influence on papilla presence in both anterior and posterior sites ( $P < .05$ ), whereas the width between roots of adjacent teeth did not. The papilla was missing more frequently in anterior sites. The presence of papillae was not age-dependent. (Int J Periodontics Restorative Dent 2012;32:e68–e74.)*

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There is great concern among periodontists, restorative dentists, and patients regarding the increased demand for an esthetic appearance.<sup>1,2</sup> Restoration and maintenance of the interproximal gingival papilla is a real challenge in modern esthetic dentistry since loss of the papilla may lead to disturbing cosmetic deformities, phonetic problems, and lateral food impaction.<sup>3–6</sup> Interproximal gingival tissue regeneration in single-tooth implant placement adjacent to a natural tooth is continually investigated since it is difficult to delineate the peri-implant mucosa, gingiva, and their mutual influence on obtaining peri-implant papillae.<sup>7–9</sup>

Better understanding of the components of the dentogingival junction (connective tissue attachment, junctional epithelium, and sulcus) was provided by Gargiulo et al in 1961.<sup>10</sup> They stated that there was a constant proportional pattern between the dentogingival junction and other tooth-supporting tissue dimensions. The authors observed that as age increased and passive dental eruption occurred,

the junctional epithelium was the most variable part of the dento-gingival junction, while the most constant part was connective tissue attachment. These findings allowed concepts to be established regarding the biologic distances of dental epithelium and connective tissues, including measurements related to interproximal gingival papillae.<sup>10</sup>

The most limiting factor in all surgical papillary reconstructive and augmentation techniques is insufficient blood supply.<sup>11</sup> The interdental recipient space borders on nonvascularized tooth surfaces that provide a restricted surface area for grafting.<sup>11</sup> While several surgical approaches for interproximal gingival papillary reconstruction have been suggested,<sup>12-17</sup> there is limited information about factors related to the interdental recipient space that may determine the presence or absence of the papilla.<sup>18</sup> To determine whether the distance from the base of the contact point to the bone crest could be correlated with the presence or absence of the interproximal papilla, Tarnow et al<sup>18</sup> examined 288 interproximal sites in humans. Although the authors examined the presence of the papilla on anterior and posterior interproximal areas, they did not discriminate between these areas. However, it is well established that there are significant morphologic differences between anterior and posterior interproximal areas.<sup>19</sup> Therefore, a study of the variables related to interproximal papilla formation should incorporate the differences between these areas.

The purpose of this *in vivo* study was to evaluate whether the height between the contact point and bone crest and the width between the roots of adjacent teeth might influence the presence or absence of interproximal gingival papillae while considering the potential differences between anterior and posterior interproximal areas. This study also investigated whether the presence or absence of interproximal gingival papillae could be age-dependent.

## Method and materials

This study comprised 45 patients (50.8% women, 49.2% men), and a total of 118 randomly selected interproximal sites were examined. Of these, 45 were anterior sites (between the maxillary central incisors) and 73 were posterior sites (between the maxillary canine and first premolar). The inclusion criteria consisted of patients who had an intact maxillary dentition or satisfactory clinical restorations. Exclusion criteria were as follows: daily doses of medication, cigarette smoking, history of systemic diseases, and orthodontic treatment. All patients that participated in the study signed an informed consent form, and an appropriate university authority accepted the research protocol.

Prospective subjects were given accurate clinical and radiographic examinations to assess whether there was any potential periodontal pathology that might interfere with

the measurements. Patient preparation included careful scaling and root planing of all teeth, prophylaxis, and oral hygiene instructions.

The same operator performed all clinical and radiographic evaluations. The presence or absence of the interproximal papilla was determined visually. Measurements were only performed on sites that presented closed contact points. Thus, if there was space between the evaluated contact points (diastema) no measurements were made (Fig 1). Papillae were considered present when the gingival tissue filled the embrasure space (Fig 2).

After clinical evaluation, patients underwent radiographic measurement to collect data for quantitative analysis of the distances. The radiographic images were made on superimposed grids with millimeter calibration, allowing the measurements obtained to provide accurate results. All measurements were taken under 1× loupe magnification (VH). One standardized periapical radiograph of the maxillary central incisors using the paralleling technique and two bitewing radiographs between the maxillary canine and first premolar were taken on the right and left sides.

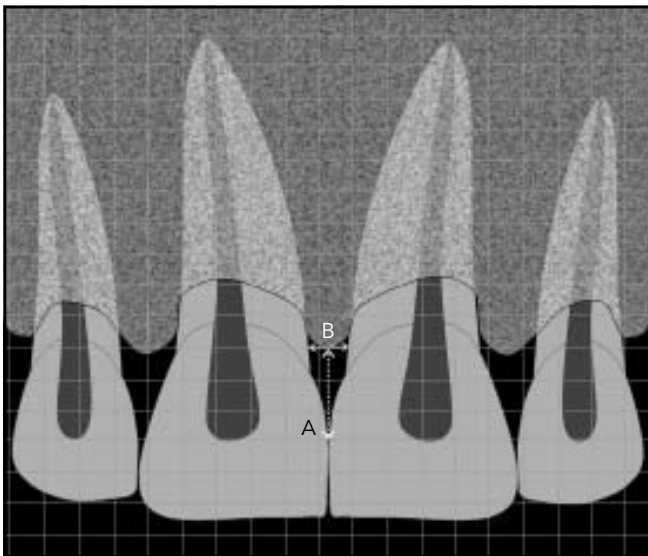
Each interproximal crestal area was examined on the radiographs, and the distance from the contact point to the most cervical region of the bone crest (height) was measured. In addition, a measurement was made of the distance between the two roots of the adjacent teeth (width) at the bone crest. A drawing of the interproximal papilla height



**Fig 1** Representative interproximal area in which the papilla was considered absent.



**Fig 2** Representative interproximal area in which the papilla was considered present.



**Fig 3** Location of measurements for interproximal papillary radiographic evaluation. A = distance from the contact point to the most cervical region of the bone crest; B = distance between the two roots of the adjacent teeth.

and width measurement locations can be seen in Fig 3.

The patients were divided into three groups ( $n = 15$ ) according to age. Group 1 consisted of subjects aged 20 to 30 years, group 2 from 31 to 40 years, and group 3 from 41 to 50 years.

The chi-square test was used to examine the influence of interproxi-

mal site location (anterior or posterior) and the effect of age on the presence of papillae ( $\alpha = .05$ ). The influence of the distance from the contact point to the most cervical region of the bone crest (height) and the distance between the two roots of the adjacent teeth (width) on the presence of papillae was examined using the Student  $t$  test ( $\alpha = .05$ ).

## Results

The results showed that the papilla was present in 95 (80.5%) of 118 interproximal sites evaluated (Table 1). Of these, 28 (62.2%) were found in anterior sites and 67 (91.8%) in posterior sites. When the papilla was considered missing, 17 (37.8%) corresponded to anterior sites and

6 (8.2%) to posterior sites. The chi-square test revealed that there was a statistically significant difference ( $P = .0002$ ) between anterior and posterior sites with the presence or absence of interproximal papillae. The papilla was missing more frequently in anterior sites (Table 1).

Radiographic examination of the interproximal papilla showed that the mean apicocoronal heights were 5.17 mm in anterior sites and 4.71 mm in posterior sites. The mean mesiodistal widths obtained were 2.04 mm in anterior sites and 1.97 mm in posterior sites. When the papilla was present, the mean values of the distance from the contact point to the crest of bone were 4.64 mm in anterior sites and 4.61 mm in posterior sites. In addition, the mean values of the distance between the roots of the adjacent teeth were 2.07 mm in anterior sites and 1.97 mm in posterior sites (Table 2). When the papilla was missing, the mean height values were 6.00 mm in anterior sites and 5.83 mm in posterior sites, and the mean widths were 2.00 mm in anterior sites and 2.33 mm in posterior sites. Table 2 shows that there was a significant difference between the crestal bone height to the contact point with the presence/absence of papillae ( $P < .05$ ) irrespective of site location. No statistical difference was noted between the mesiodistal widths with the presence/absence of papillae (Table 2).

The influence on the presence/absence of papillae was evaluated in a range of distances between the contact point to bone crest (Table 3).

	Anterior		Posterior		Total	
	n	%	n	%	n	%
Papilla present	28	62.2	67	91.8	95	80.5
Papilla absent	17	37.8	6	8.2	23	19.5
Total	45	100.0	73	100.0	118	100.0

\*Chi-square = 13.67,  $P = .0002$ .

Measurement	Papilla present		Papilla absent		t	P
	Mean	SD	Mean	SD		
<b>Anterior</b>						
Height	4.64	0.73	6.00	0.71	6.11	< .0001*
Width	2.07	0.60	2.00	0.35	0.44	.650
<b>Posterior</b>						
Height	4.61	0.62	5.83	0.75	4.50	< .00002*
Width	1.97	0.52	2.33	0.81	1.55	.123

SD = standard deviation.  
\*Significant difference ( $P < .05$ ).

When the distance was 4 mm or less, the papilla was always present, irrespective of the site location. The results also showed that when the distance was 5 mm, the papilla was present 76.9% of the time in the anterior region and 94.5% of the time in the posterior region. When the mean height values were equal to 6 mm, the papilla was found to

be present only 26.6% of the time in anterior sites and 57.1% of the time in posterior sites. When the measurements were 7 mm or more, there was no papilla in either anterior or posterior sites.

Presence or absence of interproximal papillae according to age groups is presented in Table 4. The results of the chi-square test

**Table 3** Presence or absence of papillae in a range of height measurements

Height	Anterior sites				Posterior sites			
	Papilla present		Papilla absent		Papilla present		Papilla absent	
	n	%	n	%	n	%	n	%
3 mm	–	–	–	–	1	100.0	0	0.0
4 mm	14	100.0	0	0.0	28	100.0	0	0.0
5 mm	10	76.9	3	23.1	34	94.5	2	5.5
6 mm	4	26.6	11	73.4	4	57.1	3	42.9
7 mm	0	0.0	2	100.0	0	0.0	1	100.0
8 mm	0	0.0	1	100.0	–	–	–	–

**Table 4** Percentage of interproximal papillae according to age groups\*

Age	Papilla present		Papilla absent	
	n	%	n	%
20 to 30 y	9	60.0	6	40.0
31 to 40 y	12	80.0	3	20.0
41 to 50 y	7	46.7	8	53.3

\*Chi-square = 3.59,  $P = .166$ .

showed that there were no significant differences among the age groups evaluated ( $P > .05$ ).

## Discussion

The results of the present study generally agreed with those obtained by Tarnow et al,<sup>18</sup> who found a significant influence of the height from the base of the contact area to

the bone crest on determining the presence or absence of interproximal gingival papillae. This finding might be attributed to the regenerative potential of the periodontal ligament. Periodontal ligament, alveolar bone, and cementum synthesis and deposition are functions of periodontal ligament cells and endosteal cells present in the alveolar bone.<sup>20</sup> At present, maintenance of the supporting alveolar

bone is supposed to be dependent on normal tooth functioning.<sup>21</sup> Functional stimulation is unlikely to be transmitted without an intact periodontal ligament.<sup>19</sup> Therefore, one could suppose that the height from the base of the contact area to the bone crest is correlated with the presence of a periodontal ligament that allows adequate interproximal papilla formation in these areas.

Although Tarnow et al<sup>18</sup> examined 288 interproximal sites in humans, they did not discriminate between anterior and posterior interproximal areas. The present investigation clearly demonstrated that there was no similarity between the presence or absence of interproximal gingival papillae in anterior and posterior areas. The results showed that the absence of interproximal gingival papillae was more frequently observed in anterior areas. These results could be related to morphologic differences observed between anterior and posterior interproximal tissues.<sup>19</sup> The posterior interalveolar septum has a larger area and, therefore, a greater interproximal blood supply than the anterior interalveolar septum. Thus, the shape of the interproximal gingiva appears to be influenced by tooth morphology.<sup>19</sup> According to Gargiulo et al,<sup>10</sup> connective tissue attachment may have significant influence on preserving a suitable biologic distance. One can suggest that the posterior interproximal areas probably have a larger connective tissue attachment than the anterior interproximal areas, thus facilitating appropriate formation and maintenance of the interproximal papilla. On the other hand, the results of the present study showed that the width between the roots of adjacent teeth did not significantly contribute to the presence of interproximal gingival papillae in posterior and anterior areas. Therefore, the presence or absence of interproximal gingival papillae was more likely to be related to the

height from the base of the contact area to the bone crest.

In the present investigation, the presence or absence of interproximal gingival papillae was not observed to be significantly age-dependent. However, it is interesting to note that the absence of the papilla appeared to be more frequent in patients between 41 and 50 years of age. Further research is required to explain these results.

The results of this study should be interpreted with caution since other variables, such as degree of inflammation, pocket depth of the adjacent teeth, fibrous or edematous nature of the tissue, history of previous nonsurgical therapy, and the presence of proximal restorations, could contribute to the presence or absence of the interproximal papilla. The importance of such variables remains to be investigated.

## Conclusions

Within the limitations of this in vivo study, the following conclusions were drawn:

- The height from the base of the contact area to the bone crest determines the presence or absence of interproximal gingival papillae in both posterior and anterior sites.
- The width between the roots of adjacent teeth had no significant influence on the presence or absence of interproximal gingival papillae in both posterior and anterior sites.

- Anterior gingival sites displayed absence of interproximal papillae more frequently than posterior sites.
- Presence or absence of interproximal gingival papillae was not significantly affected by age.

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