

# Anatomic variables affecting interdental papilla

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## ABSTRACT

**Aim:** The aim of this study is to evaluate the anatomic variables affecting the interdental papilla. **Materials and Methods:** Thirty adult patients were evaluated. Papilla score (PS), tooth form/shape, gingival thickness, crest bone height and keratinized gingiva/attached gingiva were recorded for 150 inter proximal sites. Data were analyzed using SPSS software package (version 7.0) and the significance level was set at 95% confidence interval. Pearson's correlation was applied to correlate the relationship between the factors and the appearance of the papilla. **Results:** Competent papillae (complete fill interdentally) were associated with: (1) Crown width (CW): length  $\geq 0.87$ ; (2) bone crest-contact point  $\leq 5$  mm; and (3) inter proximal gingival tissue thickness  $\geq 1.5$  mm. Gingival thickness correlated negatively with PS ( $r = -0.37$  to  $-0.54$ ) and positively with tissue height ( $r = 0.23$ – $0.43$ ). Tooth form (i.e., CW to length ratio) correlated negatively with PS ( $r = -0.37$  to  $-0.61$ ). **Conclusion:** Gingival papilla appearance was associated significantly with tooth form/shape, crestal bone height and interproximal gingival thickness.

**Key words:** Crest bone height, gingival thickness, interdental papilla, tooth form/shape

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## INTRODUCTION

The existence of interdental papillae and healthy gingiva harmonizing with the natural dentition is one of the important esthetic aspects that need to be considered for dental treatment and diagnosis. The interdental area, which consists of the contact area, the embrasure, and the dentogingival complex, is a physical space between adjacent teeth, with four pyramidal embrasures: Cervical, occlusal, buccal, and lingual. The interdental papilla occupies the cervical embrasure. The shape and health of interdental papillae are important in esthetic dental therapy and in functions, including the prevention of food impaction and normal pronunciation. The loss of gingival papilla height can result in open gingival embrasures, phonetic problems, food impaction, and esthetic concerns.<sup>[1]</sup> We should therefore understand the factors that influence papilla form in order to prevent papilla loss and to better understand the challenges of regenerating lost gingival papilla. Therefore, the aim of this study was to examine factors that may influence the appearance of interdental gingival papillae.

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## REVIEW OF LITERATURE

Tarnow *et al.* designed a study to determine whether the distance from the base of the contact area to the crest of bone could be correlated with the presence or absence of the inter proximal papilla in humans.

The results showed that when the distance from the inter proximal contact point (IPC) to crestal bone was  $< 5$  mm, the papillae completely filled embrasures 100%, when IPC was 6 mm it was 56% and when IPC was  $> 7$  mm it filled only 27%.<sup>[2]</sup> They suggested that other factors might contribute to a complete fill, such as inter proximal distance (IPD) and total embrasure space volume.<sup>[3]</sup>

Kim *et al.* (2008) in the longitudinal study reported that sites with IPD  $< 0.8$  mm were 28% more likely to lose  $\geq 0.5$  mm of bone and 56% more likely to lose  $\geq 1.0$  mm over 10 years.

Cho *et al.* (2006) demonstrated that the number of papillae that filled embrasures decreased with the increasing IPD, and papillae were always lost when IPD was  $\geq 4$  mm.

Martegani *et al.* also showed that increasing the IPD between roots corresponded to an increase in the distance from the IPC to papilla tip. Thus, interdental space can affect papilla height.<sup>[4]</sup>

Tooth form or shape is categorized frequently as ovoid, triangular or square. Teeth with tapered, triangular-shaped crowns have been described as having a thin gingival “biotype,” with highly scalloped gingival margins, thin alveolar bone and small proximal contacts located near their incisal edges. It has been suggested that thin periodontal “biotype” may respond to gingival inflammation with recession of the gingival margin (Weisgold 1977, Seibert and Lindhe 1989).

Square-shaped crowns, on the contrary, usually have a thick periodontal “biotype” with longer and more apically positioned contacts. As a result, square-shaped teeth tend to have a lower risk of gingival recession and require less tissue to fill the inter proximal space (Olsson and Lindhe 1991, 1993, Kois 2004).<sup>[5,6]</sup>

Hirschfeld 1923,<sup>[7]</sup> Morris 1958, Wheeler 1961, Weisgold 1977 also revealed that tooth shape may affect the shape of the periodontium.

## MATERIALS AND METHODS

The study was conducted in the Department of Periodontology, MGV'S Dental College and Hospital, Nashik, Maharashtra, India. Thirty patients (males 16: females 14) were screened with 150 inter proximal sites and were enrolled in the study. Subjects were given informed consent before the participation. A single calibrated examiner performed all the clinical evaluation. The clinical baseline examination of the subjects included assessments of oral hygiene status, gingivitis, probing pocket depth, and probing attachment level. Color photographs were obtained from the maxillary anterior teeth segment of each participating subject.

The examiner performed the following assessments at the initial screening visit: Medical and dental history, dental, and periodontal examination.

### Inclusion and exclusion criterion

Patients were included in the study if they were healthy adults >18 years of age, had no history of smoking, no significant systemic disease, including uncontrolled diabetes, hypertension, immunosuppressive diseases and other systemic diseases known to influence the papillae appearance.

Patients were excluded if they had history of periodontal surgery, inter proximal restorations, inter proximal caries, severe mal-position, absence of proximal contact, gingival overgrowth.

### Study examination

The examiner performed all assessments and measurements. Clinical measurements were limited to

the facial aspects of the maxillary canines and incisors. Each interdental papilla was given a papilla score (PS) of 0-3 based upon Nordland and Tarnow's classification system:<sup>[8]</sup>

- Normal (0) = Interdental papilla fills embrasure space to the apical extent of the interdental contact point/area;
- Class I (1) = The tip of the interdental papilla lies between the IPC and the most coronal extent of the inter proximal cemento-enamel junction (CEJ);
- Class II (2) = The tip of the interdental papilla lies at or apical to the inter proximal CEJ, but coronal to the apical extent of the facial CEJ; and
- Class III (3) = The tip of the interdental papilla lies level with or apical to the facial CEJ.

In addition, based on this score, the papilla was defined as competent when PS = 0 or deficient when PS > 1.

### Loss of papilla height

It was measured from the papilla tip to the apical terminus of the IPC using a UNC-15 periodontal probe. Papilla height was then calculated by subtracting the loss of papilla height from the crestal bone height [Figure 1].

### Crest bone height

It was measured by administering local anaesthesia for each mesio-facial or disto-facial test site. UNC-15 periodontal probe was positioned in the gingival sulcus, parallel to the long axis of the tooth and as far inter proximally as possible, and then inserted it until the probe contacted bone [Figure 2]. The distance from the crestal bone to the most apical extent of the IPC area was then recorded as the crestal bone height. The incisocervical length of the interdental contact area was also measured.

### Gingival thickness

It was determined using UNC-15 probe. The thickness of the facial gingiva was measured at the base of the papilla, which is defined as the point of intersection between a line drawn tangent to the most apical extent of the gingival margins of two adjacent teeth, and a line perpendicular to the first line that passes through the tip of the gingival papilla<sup>[9]</sup> [Figure 3].

### Tooth form/shape

It was determined by measuring the ratio of the width of each crown to its length (CW/CL). CL was defined as the distance from the gingival margin to the incisal edge or cusp tip of the crown. CW was determined by measuring the distance from the most apical extent of the proximal contact on the mesial surface to the similar point on the distal surface of each tooth [Figure 4].



**Figure 1:** Measurement of loss of papilla height



**Figure 2:** Measurement of crest bone height



**Figure 3:** Measurement of gingival thickness



**Figure 4:** Measurement of tooth form/shape

### Keratinized gingiva/attached gingiva

It was determined using UNC-15 probe. Keratinized gingiva (KG) was measured from gingival margin to the mucogingival junction. Attached gingiva (AG) was then calculated by subtracting the marginal gingiva from the KG.

### Data analysis

Data were analyzed using SPSS software package (version 7.0) (IBM SPSS Statistics) and the significance level was set at 95% confidence interval. Pearson's correlation was applied to correlate the relationship between the factors and the appearance of the papilla. For all study measurements, the examiner attained a *k* value of 95% agreement.

## RESULTS

### Impact of tooth form/shape on the appearance of papilla

The competent papilla group always illustrated significantly greater CW/CL ratios on adjacent teeth than the papilla deficient group. The CW/CL ratio in the competent papilla group ( $PS > 0$ ) was  $\geq 0.87$  ( $P = 0.05$ ) ( $r = -0.02$ ) [Table 1].

### Impact of crestal bone level on the appearance of papillae

The interdental papillae always filled the interdental space when the distance from proximal contact to bone crest (BC) was  $\leq 5$  mm. The crest bone height showed a positive correlation ship with the appearance of papilla ( $r = 0.3$ ) [Table 2].

### Impact of keratinized gingiva/attached gingiva tissue on the appearance of papilla

Overall, when the KG/AG was found to be wider, the papilla was competent. The KG/AG showed a positive correlation ship with the PS ( $r = 0.3$ ) [Table 3].

### Impact of gingival thickness on the appearance of papillae

The mean gingival thickness was greater with competent papilla as compared to deficient papilla. The gingival thickness showed a positive correlation with appearance of the papilla ( $r = 0.04$ ). Gingiva tended to be thicker between central incisors (1.66) [Table 4].

## DISCUSSION

In this study, we evaluated the factors such as crest bone height, gingival thickness, CW/CL ratio and KG/AG that may be associated with the dimension of gingival papilla.

**Table 1: Crown width to Crown length (CW/CL)**

Tooth no	CW/CL ratio mean $\pm$ SD	MIN	MAX
13	0.88 $\pm$ 0.12	0.72	1.30
12	0.86 $\pm$ 0.10	0.7	1.12
11	0.85 $\pm$ 0.09	0.72	1.11
21	0.84 $\pm$ 0.12	0.72	1.00
22	0.85 $\pm$ 0.12	0.6	1.16
23	0.88 $\pm$ 0.01	0.72	1.14

**Table 2: Crest bone height relation with papilla**

Tooth no	PS = 0	PS $\geq$ 1
13-12	4.1	5.0
12-11	4.15	4.7
11-21	4.2	4.9
21-22	4.6	5.1
22-23	3.9	5.1

**Table 3: Impact of KG/AG tissue on the appearance of papilla**

Tooth no	Keratinized gingiva	Attached gingiva
13	4.2	3.1
12	4.15	3.25
11	4.06	2.9
21	4.08	3.05
22	4.08	3.01
23	4.25	2.5

**Table 4: Impact of gingival thickness on the appearance of papilla**

Tooth no	PS = 0	PS $\geq$ 1
13-12	1.57	0.80
12-11	1.61	0.79
11-21	1.66	1.28
21-22	1.6	0.86
22-23	1.6	0.85
Mean	1.6	0.9

As no sex predilection has been observed for the presence of the interproximal dental papilla by Chang, 2008; Min Chien Chan *et al.* 2009, hence equal number of males and females were enrolled in the study.

We found that CW/CL ratios of teeth adjacent to competent papillae were significantly greater than those adjacent to deficient papillae, which indicate that teeth with a square form were less likely to have deficient papillae. When CW/CL was  $\geq 0.87$ , papillae always filled the interdental space.

Our results agree with previous reports of LaSota 1988, Kokich 1996, Kois 2004 that the square tooth shape favors papilla competence more than the triangular tooth shape. Kois (2004) explained that square teeth have longer proximal contacts and more tooth structure to fill the interdental area, which reduces the risk of “black triangles” compared with a triangular-shaped tooth.

In this study, the embrasure between central incisors was the most frequent site for deficient papillae (69.7%). Long-narrow

tooth form and incisally positioned IPCs may contribute to an increased incidence of incompetent papillae between maxillary central incisors.<sup>[10]</sup>

This study showed that papillary appearance was significantly associated with the vertical distance from the alveolar BC to the IPC (BC/IPC), which confirms findings from previous studies (Tarnow *et al.* 1992, Wu *et al.* 2003). The BC level displayed a strong positive correlation with the PS and moderate positive correlation with papilla height. The papilla almost always filled the interproximal embrasure when the vertical distance was  $\leq 5$  mm. In contrast, the papillae usually did not fill the interproximal spaces when the distance was  $> 5$  mm.

Our findings agree with Tarnow *et al.*, who reported that 44% of gingival embrasures were open when BC/IPC was 6 mm, increasing to 73% as the distance increased to 7 mm. In addition, Kurth and Kokich (2001) demonstrated that a 1 mm increase in BC/IPC increases the odds of an open gingival embrasure by 78-97%. Chang also reported that each 1 mm increase in BC/IPC increases the risk of papilla recession by 3.04-fold, and the BC to CEJ distance is the strongest predictor of the probability of papillary loss.<sup>[10]</sup>

We found a positive correlation between gingival thickness and papilla fill in this study. Limited blood supply is believed to be one of the major reasons why papilla preservation and regeneration are difficult.<sup>[9]</sup> Thicker tissue may resist collapse and contraction due to increased vascularity and extracellular matrix volume. In addition, thicker KG epithelium may be more resistant to physical damage and bacterial ingress. Therefore, thick gingival biotype has been considered more favorable for achieving optimal aesthetics.

## CONCLUSION

Loss of interdental papillary height is often the sequel of periodontal pathology, as well as the response to periodontal therapy and the return to periodontal health. Papilla loss in the maxillary anterior region often creates a cosmetic concern in afflicted patients. The correct shape of inter proximal papilla is the key factor in anterior esthetics. To minimize the occurrence of deficient papilla in maxillary anterior, we should assess the anatomical factors (tooth shape, crest bone height, gingival thickness, KG/AG) before performing restorative or surgical treatment.

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