A study to evaluate age and gender as determinants of papillary proportions in the esthetic region

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ABSTRACT

Aim An interdisciplinary team approach to multidisciplinary therapies in esthetic restorative treatment has become common in the dental profession. 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 purpose of this study is to quantify the interdental papilla location mathematically as a percentage ratio of clinical crown length for males and females in different age groups and establish a useful parameter for treatment.
Materials and Methods Papilla heights of maxillary anterior teeth were evaluated on dental casts of 40 volunteers using digital vernier calipers. Crown height and width were measured and gingival zenith was used as the reference points. Papilla proportions were calculated for males and females in age groups 20-35 years and 36-50 years.
Result The mesial papilla proportion for canine, lateral incisor and central incisor were 42.6%, 39.8% and 39.7% respectively. The distal papilla proportion for canine, lateral incisor and central incisor were 47.5%, 39.6% and 38.6% respectively. The papilla proportions were found to be higher in males and in individuals in age group of 36-50 years.
Conclusion Gender variations exist in papilla proportions with the values being higher for males. Age appears to have an influence on papilla proportion.

KEYWORDS Interdental papilla; Gingival zenith; Age; Gender; Papilla proportion.

INTRODUCTION

Dental appearance has been shown to have an impact on people's assessment of an individual's facial attractiveness and personality (1). Esthetics is a primary consideration for patients seeking restorative treatment. An interdisciplinary team approach to multidisciplinary therapies in esthetic restorative treatment has become a routine in the dental profession (2). With increasing demands for more natural looking restorations in the esthetic zone; clinicians must strive to maintain a high level of knowledge and skill.
Healthy gingival tissue, as part of biologic structural beauty, is an important factor of esthetic perception. Depending upon the individual's anatomic features and according to the lip line, the gingival tissues are usually exposed during smile, laughter, and even during normal speech. The evaluation of normal gingival color and contour is not limited to professionals but can also be appreciated by nonprofessionals during daily social contacts. Any strange gingival contour is immediately perceived and interpreted according to its degree of deviation from normality (3).
Dental esthetics is a term which encompasses both hard-tissue and soft- tissues. The components of gingiva including the contour and height of papilla form one of the eight components of a balanced smile. The presence of papilla is not a concern only with regard to esthetics but it is also vital for maintenance of gingival health and for optimal phonetics (4). It has been long known that the clinical appearance of the healthy marginal periodontium differs from subject to subject and even among different tooth types. Many features are genetically determined: others seem to be influenced by tooth size, shape and position and biological phenomena such as gender, growth and age (5,6,7).
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 presence or absence of the interdental papilla between the teeth, between implants and teeth and between adjacent implants has received much attention in the past decade. Despite the significant attempts to standardize the protocol for development of dental esthetics, there exists variation in perception of esthetics amongst clinicians. There is no universal guideline to follow in creating greater conformity and a predictable esthetic smile, including ideal papilla heights. It may be possible to mathematically quantify certain esthetic components to establish a standard that is satisfying to both patients and clinicians (2).

The purpose of this study is to quantify the interdental papilla location mathematically as a percentage ratio of clinical crown length for males and females in different age groups, and thus establish a useful parameter for treatment.

MATERIALS AND METHOD

Forty subjects (20 males and 20 females) were randomly selected from the patients visiting the outpatient department. Volunteers selected were of Indian ethnicity, with age ranging from 20 to 50 years, who were in good systemic health, presented with all six non restored maxillary anterior teeth, no loss of interdental papilla, absence of periodontal disease, no history of parafunctional habits, periodontal surgery or orthodontic treatment and absence of crowding, rotation, diastema, incisal attrition or gingival recession of maxillary anterior teeth.

The subjects were divided into two age groups based on gender (n=20) and further subdivided based on age into younger age group (20-35 years) and older age group (36-50 years) (Table 1). Maxillary arch impressions of each volunteer were made using irreversible hydrocolloid material (Neocolloid, Zhermack, Italy) and poured immediately using type III dental stone (Kalstone, Kalabhai, India) to obtain study casts.

Gingival zenith was used as the reference point to mark the interdental papilla height, crown length and crown width. All measurements were made using a digital vernier caliper (resolution 0.01 mm; accuracy ± 0.02 mm; Absolute Digimatic Caliper, Mitutoyo, Japan) and optical loupes with 2.5X magnification (HR 2.5X; 420 mm/16″ Heine, Germany). Three readings were taken for each measurement and average values were used for tabulation. All readings were recorded by a single operator to eliminate inter- operator bias and they were spaced one week apart to eliminate intra-operator bias. The formula employed was as follows:

$$\text{Papilla proportion} = \frac{\text{Papilla height (mm)}}{\text{Crown length (mm)}} = 100.$$

Both mesial papilla proportion (MPP) and distal papilla proportion (DPP) were calculated for each of the six maxillary anterior teeth. Values obtained were subjected to statistical analysis using student t- test (Fig. 1, 2, 3).

GROUP		AGE RANGE (years)	SEX	MEAN AGE (years)	SAMPLE SIZE
Group 1	Males	20-35 years	28+1.9	10
		36-50 years	43+1.8	10
Group 2	Females	20-35 years	28+1.8	10
		36-50 years	43+1.7	10

TABLE 1 Study groups.

FIG 1 Reference lines marked on the study model for the intended study.

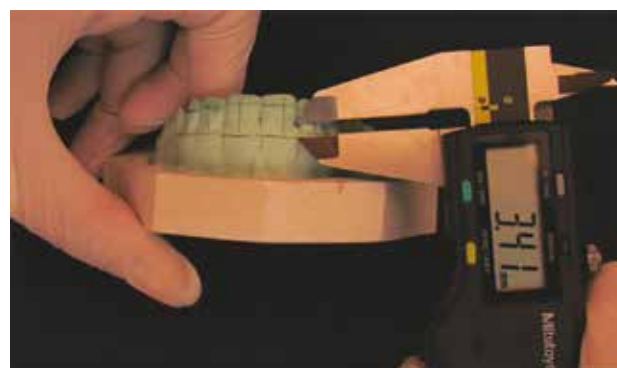FIG 2 Quantitative measurement of height of crown.

FIG 3 Quantitative measurement of papilla height. .

RESULTS

The results are reported in tables 2, 3 and 4.

DISCUSSION

Esthetics has become increasingly important in the current practice of restorative dentistry and is synonymous with natural, harmonious appearance. However beauty is not absolute and is subjective. Various studies have been conducted in an attempt to quantify the different components that affect dental esthetics (2, 9-17).

The interdental papilla, which occupies the interdental space, is a key factor in anterior esthetics and is also protective in nature, since it acts like a barrier (18).

An irregular gingival arrangement, despite being healthy, may strike a discordant note, and it may become desirable to establish a certain harmony and continuity of form to the free gingival margin (3).

It is the interdental appearance of the papillae in an apicocoronal location that is critical during smiling that result in positive gingival architecture esthetics, although the supracoronal tissues might not always be visible in patients with a low smile line (19). Tjan et al. (20) evaluated esthetic factors in a smile. They divided smile into 3 categories; high, average and low smile. It was found that 68.94% subjects have an average smile revealing 75% to 100% of maxillary anterior teeth and interproximal gingiva.

There is no universal guideline for clinicians to follow in creating greater conformity and a predictable esthetic smile, including papilla heights (2). The values of interdental papilla heights in the maxillary anterior dentition have been reported in literature.

Gingival zenith is the point of highest contour on the free marginal gingiva and its correct spatial positioning following therapeutic manipulation is mandatory since is greatly influences the emergence profile and axial inclination of the teeth; hence the proper symmetry to the entire soft tissue system.

In this study, gingival zenith was used as a reference point

Parameter	N	MPP	DPP
Right canine	40	43.06883	45.57934
Right lateral incisor	40	40.24416	38.61721
Right central incisor	40	40.12232	38.84033
Left central incisor	40	39.32642	38.50349
Left lateral incisor	40	39.53759	40.70426
Left canine	40	42.27234	49.55365

TABLE 2 Mesial and distal papilla proportion of maxillary anterior teeth.

Parameter	Age group	N	Mean	S.D	T	Df	Sig. (2-Tailed)*
Mpp right canine	20–35 years	20	40.87679	9.238984	-1.647	38	0.108
	36–50 years	20	45.26087	7.506325			
Dpp right canine	20–35 years	20	44.14633	10.05718	-1.056	38	0.298
	36–50 years	20	47.01236	6.793965			
Mpp right lateral incisor	20–35 years	20	37.85726	9.039921	-1.71	38	0.095
	36–50 years	20	42.63105	8.610577			
Dpp right lateral incisor	20–35 years	20	34.92116	11.11505	-2.607	38	**0.013**
	36–50 years	20	42.31326	6.100335			
Mpp right central incisor	20–35 years	20	38.3604	9.213961	-1.262	38	0.215
	36–50 years	20	41.88424	8.433297			
Dpp right central incisor	20–35 years	20	36.97423	9.666757	-1.378	38	0.176
	36–50 years	20	40.70644	7.29239			
Mpp left central incisor	20–35 years	20	38.06807	10.04023	-0.845	38	0.403
	36–50 years	20	40.58478	8.740957			
Dpp left central incisor	20–35 years	20	36.81512	6.985631	-1.386	38	0.174
	36–50 years	20	40.19188	8.361864			
Mpp left lateral incisor	20–35 years	20	37.87826	8.540469	-1.177	38	0.247
	36–50 years	20	41.19693	9.282209			
Dpp left lateral incisor	20–35 years	20	38.3318	9.504557	-1.656	38	0.106
	36–50 years	20	43.07672	8.596482			
Mpp left canine	20–35 years	20	38.78467	9.716386	-2.519	38	**0.016**
	36–50 years	20	45.76001	7.681509			
Dpp left canine	20–35 years	20	46.04063	9.136983	-2.492	38	**0.017**
	36–50 years	20	53.06668	8.6912			

TABLE 3

Comparison of mesial and distal papilla proportion between younger and older age group .

in males?

*- bold and underlined values are statistically significant

Parameter	Agegroup	N	Mean	S.D	T	Df	Sig. (2-Tailed)*
Mpp right canine	20-35 years	10	39.31641	6.249329	-2.783	18	**0.012**
	36-50 years	10	47.62182	7.070177			
Dpp right canine	20-35 years	10	41.12626	8.916386	-2.273	18	**0.036**
	36-50 years	10	48.65104	5.486711			
Mpp right lateral incisor	20-35 years	10	34.16032	6.904197	-1.987	18	0.062
	36-50 years	10	42.01364	10.41666			
Dpp right lateral incisor	20-35 years	10	31.32961	5.391345	-3.602	18	**0.002**
	36-50 years	10	40.86367	6.402703			
Mpp right central incisor	20-35 years	10	38.07514	7.650065	-0.753	18	0.461
	36-50 years	10	40.86403	8.876989			
Dpp right central incisor	20-35 years	10	34.74402	7.422035	-1.523	18	0.145
	36-50 years	10	39.99934	8.000493			
Mpp left central incisor	20-35 years	10	35.11644	9.012398	-1.193	18	0.248
	36-50 years	10	39.60298	7.757521			
Dpp left central incisor	20-35 years	10	35.76481	5.99825	-1.506	18	0.149
	36-50 years	10	40.49571	7.918096			
Mpp left lateral incisor	20-35 years	10	34.96623	8.624793	-1.155	18	0.263
	36-50 years	10	40.02973	10.85856			
Dpp left lateral incisor	20-35 years	10	37.6351	8.976009	-1.498	18	0.151
	36-50 years	10	43.04778	7.064383			
Mpp left canine	20-35 years	10	37.93148	8.062089	-2.806	18	**0.012**
	36-50 years	10	48.17689	8.264432			
Dpp left canine	20-35 years	10	46.04617	8.198449	-2.168	18	**0.044**
	36-50 years	10	54.82843	9.84384			

TABLE 4

Comparison of mesial and distal papilla proportion between younger and older age groups in females.

- bold and underlined values are statistically significan

and measurements were recorded on dental casts using a digital vernier caliper. Studies have been carried out to assess the gingival zenith positions in maxillary anterior dentition (10,12). However, only one previous study has used gingival zenith as reference point for determining height of interdental papilla (2). Other methods used to measure interdental papilla are: periapical radiographs, non-invasive radiographic method using semisoft radiopaque material, transgingival probing, clinical assessment and intraoral biometric measurements (13). Kois (24) measured the interdental papilla heights from free gingival margin to the osseous crest using a periodontal probe. Mesial sites at the maxillary right central incisor in healthy patients were observed and the interproximal depth in a range of 3 to 4.5 mm was reported. Spear (19) estimated that the average maxillary interproximal papilla height would be 4.5 to 5.5 mm for central incisors. According to a study performed by Chu et al. (2) the mean absolute interdental papilla heights for central incisor, lateral incisor and canine were 4.3 mm, 3.7 mm and 4.4 mm.

According to the results of this study, the absolute mean values of mesial and distal papilla for different class of teeth were 4.10 mm and 4.57 mm for canine;

3.60 mm and 3.58 mm for lateral incisor; and 4.11 mm and 4.02 mm for central incisor respectively. The values for lateral incisors and central incisors were lesser than those previously reported in the literature (2,19).

Factors associated with the appearance of gingival papillae were studied by Chow et al. (7) They reported that there was always a higher incidence of papilla deficiency in older age groups compared to younger ones; papilla height was greater for males than in females. Other associated factors are tooth form, length of contact length, the distance from contact point to crestal bone, thickness of gingiva and width of attached gingiva/keratinized gingiva.

The results of this study support the previous findings of greater papilla height in males compared to females. However, a comparison of papilla height between different age groups reveals contrary results with the height of interdental papilla being higher for individuals between 36-50 years of age.

It is important to understand that although mean absolute values are important findings, they do not account for the individual variation in crown lengths or papilla height. In order to achieve optimal esthetics in the anterior zone, the papilla height must be proportional to

the length of the clinical crown. There are not many studies in the current literature that evaluate papilla proportions.

The MPP and DPP values were compared for males and females. It was found that males had a higher values compared to females except MPP of right canine (43.3%), MPP of left canine (43.0%) and DPP of left canine (50.4%) in females, which showed a higher value than in males (42.6%, 41.4% and 48.6% respectively). The difference was however not statistically significant (p>0.05). This variation could possibly be due to the greater tooth size in males. A comparison of MPP and DPP in different age groups revealed higher values for individuals of 36-50 years age group. The difference in values was statistically significant for DPP of right lateral incisor (p=0.013), MPP of left canine (p=0.016) and DPP of left canine (p=0.017).

A comparison of MPP and DPP for different age groups in males revealed that values were higher for males aged 36-50 years except DPP of right canine. The difference was not found to be statistically significant (p>0.05). When the females of the two age groups were assessed, all values were consistently higher for women aged 36-50 years. The difference was statistically significant for MPP of right canine (p=0.012), DPP of right canine (p=0.036), DPP of right lateral incisor (p=0.002), MPP of left canine (p=0.012) and DPP of left canine (p=0.044).

A comparison between males and females in the age group 20-35 years revealed that all MPP and DPP values were higher for males but the difference was not statistically significant (p>0.05). A comparison between males and females in the age group 36-50 years revealed that MPP and DPP values were higher for males except the MPP and DPP of right and left canine; the values for which were higher in females. There was no statistically significant difference between the two groups (p>0.05).

The results of this study are contrary to the findings of Chang (21), who stated that papillary was not associated with gender but negatively correlated with age.

A total of 480 interdental sites in 40 subjects were evaluated in this study. There is further scope for the study with a higher sample size. The method employed digital vernier calipers and measurements were made on dental casts. The soft tissue displacement during impression making may have incorporated inevitable errors in readings. Intraoral biometric measurements coupled with radiographic assessment may help determine more accurate values using a non invasive procedure. A cross sectional study was done to assess the papillary proportions in the maxillary anterior dentition. To assess the influence of age on papillary height and proportion a longitudinal study can be conducted.

Beauty is subjective and depends on individuals' perception of it. However, attempting to quantify beauty in ratios and proportions provides the dental team with parameters to enhance patient's esthetics. The purpose of this study was to determine a representative value for interdental papilla height of maxillary anterior dentition as a percentage ratio of the clinical crown length as measured from gingival zenith; and to determine the variations based on gender and age. The values reported in this study can be employed for more effective communication between the dental team, can be used as reference in soft tissue contouring prior to restoring missing teeth with tooth, or implant supported prosthesis, and even for esthetic gingival re-contouring; it will also help achieve a more uniform treatment goal.

CONCLUSION

Within the limitations of this study, the following conclusions can be drawn. Papilla proportions exist for maxillary anterior dentition: the MPP for canine, lateral incisor and central incisor were 42.6%, 39.8% and 39.7% respectively. The distal papilla proportion for canine, lateral incisor and central incisor were 47.5%, 39.6% and 38.6% respectively. Gender variations exist in papilla proportions with the values being higher for males. Age appears to have an influence on papilla proportion. The values observed are higher for individuals in the age group of 36-50 years.

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