Pink Esthetics: A Study on Significant Gingival Parameters

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Abstract

Aim: The aim of the study was to quantify the specific spatial displacement of gingival zenith (GZ) and determine a representative value for the interdental papilla height as a percentage ratio of clinical crown length (CL), as measured from GZ in the maxillary anterior dentition.

Materials and methods: A total of 100 subjects and 1,200 interdental papillae were included. Eighty percent of the population presented with the gingival margin of lateral incisor (LI) teeth positioned coronally to the GZ of the ipsilateral canine (C) and central incisor (CI).

Results: No significant difference was found between mesial and distal papilla proportion (DPP) of maxillary incisor groups. In the C group, numerical values showed higher DPP.

Conclusion: The data achieved provide the ideal numerical values for prosthetic, restorative, periodontal, implant, postorthodontic, and esthetic treatment outcomes.

Clinical significance: The study describes the importance of quantifying the ideal numerical values for prosthetic, restorative, periodontal, implant, postorthodontic, and esthetic treatment outcomes. The readers should understand to quantify the specific spatial displacement of GZ and determine a representative value for the interdental papilla height as a percentage ratio of clinical CL, as measured from GZ in the maxillary anterior dentition.

Keywords: Dental esthetics, Gingival zenith, Interdental papilla, Maxillary anterior, Surgery, Tooth anatomy.

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Introduction

Smile esthetics play an important role in the perception of an individual's personality.[1] The perception of facial beauty is multifactorial. Esthetics is the study that assesses and comprehends beauty, proportions, and symmetry.[2] It is a fusion of art and science, and all the variables considered are interdependent and interrelated, hence it is difficult to define the ideal smile.[3]

There has been great advancement over the years in the field of esthetic dentistry to establish a balance in ideals of beauty with optimal health and function.[4] Smile analysis involves evaluating the teeth, lip framework, and gingival scaffold, i.e., the ideal fusion of pink and white esthetics. The abnormalities in the symmetry and contour disturb the look of the natural and prosthetic restored dentition.[5]

Gingival zenith (GZ) is outlined as the most apical point of gingival marginal scallop. It has a precise spatial orientation in the apicocoronal and mesiodistal directions. Mesiodistally it is located just distal to the long axis of CIs and Cs and is concurrent with the long axis of LIs. Apicocoronally zenith on CIs and Cs is at the same height and on the LIs is slightly coronal. The visibility of interdental papilla results in positive architecture esthetics while smiling.[6,7]

The harmony between white esthetics and pink esthetics is enhanced by correct spatial positioning of zenith, which in turn influences the emergence pattern, and axial placement of teeth. This modifies the line angle locus of long axis of crown emergence from gingiva adding equilibrium to entire soft tissue system.[8] Gingival bioform is the different scallop morphologies of the marginal and interdental gingiva. There is a difference in the clinical appearance of the marginal gingiva and tooth types in different individuals. Apart from genetic predisposition, morphologic characteristics of the periodontium is influenced by a variety of factors such as size, shape, and position of tooth and physiologic processes like growth, aging, etc. Gingival biotype is affected by gingival thickness and crown

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width (CW); and crown length (CL), papilla height, and gingival width determine the gingival bioform which includes the GZ.

Different studies were also done in a variety of ethnic groups to evaluate the influence of white esthetics on pink esthetics.

AlQahtani et al. evaluated the smile line, gingival angle, and tooth shape among a subpopulation of the Saudi Arabia and their connection with gingival biotype.[9] They concluded statistically significant relationship between thick gingival biotype, the square tooth, and high smile line. The high gingival angle was allied with thin gingival biotype. In all, 56.8% demonstrated tapering tooth morphology, 53% showed thick gingival biotype, while 57.5% had average smile line.

Barakat studied Syrian population for determining the predominance of gingival biotypes.[10] In all, 58.4% people showed thick gingival biotype, 41.6% had thin gingival biotype, while 99.5% of them had triangular tooth shape.

Lee determined the facial gingival profiles of teeth with a healthy periodontium in an Asian population.[11] A high percentage of anterior teeth had thin marginal gingiva.

Rathee evaluated the prevalence of various gingival biotypes and corroborated gingival thickness and gingival biotypes across tooth type, site, and gender in Young Dentate North Indian Population.[12] In all, 70 to 73% of CI showed tendency toward thin biotype variant compared with only 23–28% with thick biotype variant.

Shah conducted a study in a South Indian population and stated that thin biotype was prevalent in 43.25%, while thick gingival biotype was seen in 56.75%.[13]

The above studies surveyed a variety of population and different ethnic groups. Thus, ethnic differences impact the distribution of gingival biotypes and tooth morphology. These factors can determine the location of GZs.

There is a lack of universal guidelines along with the standardization and communication to achieve consistent outcomes of the esthetic treatment plan. Hence, there is a need to establish a mathematical quantification of certain esthetic components that satisfies both the patients and clinicians.[14]

Not many studies have been conducted to calculate GZ and the interdental papilla height parameters in the West Indian population. Hence the purpose of this study was to quantify the specific spatial displacement of GZ and to define a representative value for interdental papillary height as a percentage ratio of clinical CL as determined from GZ.

MATERIALS AND METHODS

A sample size of total 100 adult subjects (42 males and 58 females) between the age-group of 20–23 years with healthy periodontium was included in the study. Sample size computation was done using the expected prevalence of coincident GZ with the long axis of tooth as 40.66%. A sample size of 100 had a precision of 0.1 at a confidence interval of 95%.

The study was carried out in accord with the Helsinki declaration of 1975, as revised in 2000.[15] The protocol for all procedures was approved by the Institutional Review Board for Ethical Clearance of AECS Maaruti College of Dental Sciences and Research Centre Bengaluru. Subjects were informed prior and a valid informed consent was taken.

Inclusion criteria was patients who were older than 20 years, absence of bleeding on probing, suppuration, recession (REC), probing depth (PD) <3 mm, no loss of interdental papillae, crowding, spacing, incisal alteration, and consistency firm and resilient.

Exclusion criteria was diseases/conditions and medications affecting gingival status, gingival alterations, attachment loss, history of periodontal, orthodontic, restorative treatment, and trauma and occlusal wear of more than 1 mm into dentin.

Clinical Data

Probing depth, REC, and probing attachment level were measured using UNC 15 probe (HU-FRIEDY).

Impression Technique

A maxillary stock tray of an appropriate size was selected. Maxillary impression was taken using additional silicone material (GC Flexceed Putty). The impression was poured using type IV dental stone (Gyprock, India).

Morphometric Analysis

Reference lines were marked for morphometric analysis. The measurements were taken bilaterally in the C, LI, and CI teeth using a digital vernier caliper (Aerospace Digimatic Vernier Caliper). The CW was marked at maximum CW, and long axis-clinical crown length (CL) was marked as (LA) which bisected the CW. The GZ was the most apical point of gingival marginal scallop. Zenith line (ZL) was the horizontal line connecting gingival zenith (GZ) from the ipsilateral canine (C) and central incisor (CI) teeth. The GZ–LA and LI–GZ lines were drawn (Fig. 1). Papillary height measurements were determined from the level of the GZ to the tip of the mesial papilla (MPH) and the distal papilla (DPH) for the CI, LI, and the C (Fig. 2). Each papilla height (PH) measurement was segmented by the clinical CL LA, and a percentage ratio was calculated. The MPH proportions (MPPs) and DPPs were analyzed individually using the formula $MPP = MPH/CL \times 100\%$, and $DPP = DPH/CL \times 100\%$. Measurements were documented to the nearest 1/100th mm. Duplicate measurements were achieved for every tooth and averaged.
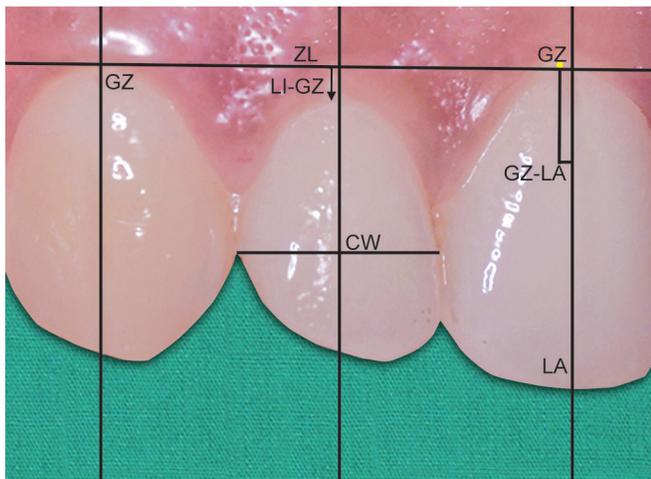

Fig. 1: Measurements performed in morphometric analysis. Gingival zenith is the most apical point of gingival zenith. The GZ–long axis distance is defined as the discrepancy between the GZ and the long axis of the tooth, lateral incisor–GZ distance is defined as the vertical discrepancy between the zenith line and the zenith of the ipsilateral LI
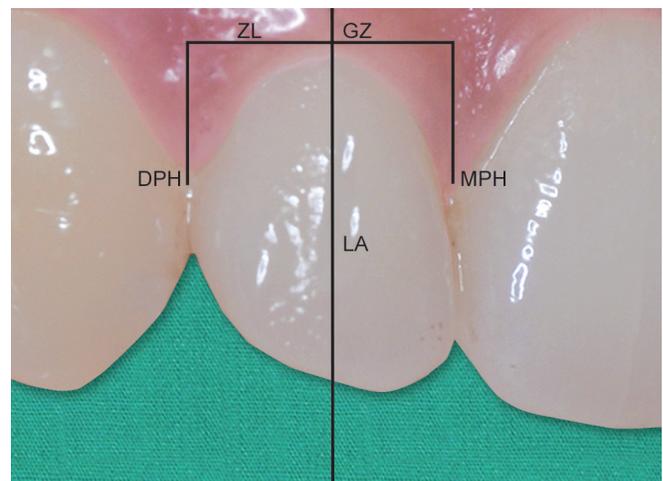

Fig. 2: Measurement performed in morphometric analysis. Each papilla height (PH) measurement was divided by the clinical crown length and a percentage ratio was calculated

Table 1: Values showing the distal displacement of the gingival zenith in relation to the long axis of the tooth

Measurement	RC	RLI	RCI	LCI	LLI	LC
Mean ± SD (mm)	0.15 ± 0.30	0.36 ± 0.42	0.84 ± 0.38	0.87 ± 0.49	0.43 ± 0.40	0.06 ± 0.24
Range—min/max (mm)	0.0/0.9	0.0/1.3	0.0/1.6	0.0/1.75	0.0/1.40	0.0/1.2

RC, right canine; RLI, right lateral incisor; RCI, right central incisor; LCI, left central incisor; LLI, left lateral incisor; LC, left canine; Min/max, minimum/maximum values; SD, standard deviation

Table 2: Values showing the prevalence percentage of the coincidence of the position of the gingival zenith with the long axis of the tooth

	RC	LC	RLI	LLI	RCI	LCI	Total
Coincide (%)	88	96	22	28	4	8	41
Mean (%)	92		25		6		
$p < 0.05$							
Diverge (%)	12	4	78	72	96	92	59
Mean (%)	8		75		94		
$p < 0.05$							

RC, right canine; RLI, right lateral incisor; RCI, right central incisor; LCI, left central incisor; LLI, left lateral incisor; LC, left canine

Table 3: Values showing the coronal displacement of the gingival zenith of the maxillary lateral incisor

	RLI	LLI	Total
Mean ± SD	0.80 ± 0.66	0.85 ± 0.68	0.85 ± 0.68
Range (mm)	0.40–1.5	0.44–1.8	0.44–1.8
p value	0.40 (NS)		

RLI, right lateral incisor; LLI, left lateral incisor; SD, standard deviation

Results

All results are stated as mean ± standard deviation (SD). Intermeasurement disparities were studied by paired t test for continuous variables and the χ^2 test for percentages. $p < 0.05$ was used to affirm statistical significance (Tables 1 and 2).

In Cs, the long axis of crown is coincident with zenith in 88% of right and 96% of left. In the right C, a distal displacement of 0.15 ± 0.30 mm was seen. Zenith was not coincident in 12%, with distal displacement minimum of 0.0 mm and maximum of 0.9 mm. In the left C a distal displacement of 0.06 ± 0.24 mm was seen. Zenith was not coincident in 4% with distal displacement minimum of 0.0 mm and maximum of 1.2 mm. Due to statistical insignificance (paired t test $p = 0.25$), it was concluded that right and left C demonstrated contralateral symmetry.

In LIs, the long axis of crown is coincident with zenith in 22% of right and 28% of left. In the right LIs, a distal displacement of 0.36 ± 0.42 mm was seen. Zenith was not coincident in 78%, with distal displacement minimum of 0.0 mm and maximum of 1.3 mm. In the left LIs, a distal displacement of 0.43 ± 0.40 mm was seen. Zenith was not coincident in 72% with distal displacement minimum of 0.0 mm and maximum of 1.4 mm.

In CIs, the long axis of crown is coincident with zenith in 4% of right and 8% of left. In the right CIs, a distal displacement of 0.84 ± 0.38 mm was seen. Zenith was not coincident in 96%, with distal displacement minimum of 0.0 mm and maximum of 1.6 mm. In the left CIs, a distal displacement of 0.87 ± 0.49 mm was seen. Zenith was not coincident in 92% with distal displacement minimum of 0.0 mm and maximum of 1.75 mm.

It was inferred that mesial displacement of GZ was not seen in any tooth groups of the maxillary anterior region.

Contralateral symmetry was observed for distal displacement of all teeth group. Distal displacement was maximum in CIs followed by LIs and Cs (χ^2 test $p < 0.05$). Maximum of population showed gingival margin positioned coronal to zeniths of ipsilateral C and CI teeth.

Coronal Displacement of the LI Zenith (Table 3)

A majority of the cases (80%) presented with the gingival margin of LI teeth positioned coronally to the zeniths of the ipsilateral C and CI teeth. Such coronal displacement amounted to 0.80 ± 0.66 mm (range, 0.40–1.5 mm) for right LI and 0.85 ± 0.68 mm (range, 0.44–1.8 mm) for left LI. These differences were statistically insignificant (paired t test; $p = 0.40$). Of the cases studied, 17% presented with the gingival margin of LI teeth situated at the same level of the zeniths of the ipsilateral C and CI teeth. In 3% of the cases, the LI was sited apically to the neighboring teeth.

Papillary Proportions (Table 4)

The MPPs for the CI, LI, and C were 38, 34.5, and 40%, respectively. The DPPs of the CI, LI, and C were 38.5, 36, and 40.5%, respectively. No significant difference was observed between MPP and DPP of maxillary incisor groups. In the C group, the numerical values showed higher DPP.

Discussion

The results of the current study concluded that distal movement of GZ was not a universal feature. The most anterior tooth showed greater distal displacement of GZ. This was in agreement with the previous study done by Mattos and Santana, which stated that the GZ was distally displaced between 0.06 and 0.96 mm in 12, 70, and 96% of the C, LI, and CI teeth, respectively.[16] Seventy percent of the population presented with the GZ of LI teeth placed coronally to the GZ. Chu revealed a GZ had a mean value of 1 mm distal from the vertical bisected midline for the CI tooth group.[17] The LIs displayed a mean of 0.4 mm. The C tooth group revealed no deviations in the GZ from the vertical bisected midline. The GZ of the LIs related to the adjacent CI and C teeth were more coronal by 1 mm approximately. Stein and Kay proposed that the zenith is distal to the long axis of CI and LI teeth.[18,19] Magne and Belser and Morr proposed that the zenith is distal to the long axis of CI, LI, and C teeth.[20,21] Cho et al. concluded that the interradicular distance and the distance between the contact point and the alveolar crest have separate and joint effects on the presence or absence of interdental papilla.[22] Tarnow et al. examined the distance from the base of the contact area to the crest of bone in 288 sites and determined that at 5, 6, and 7 mm the papilla was present 98, 56, and 27% of the time, respectively.[23] Kois measured mesial sites at the maxillary right CI in 100 healthy patients and he reported a interproximal depth range of 3–4.5 mm.[24] In the present study, the average MPP for the CI, LI, and C were 38, 34. 5, and 40%, respectively. The DPPs of the CI, LI, and C were 38.5, 36, and 40.5%, respectively. These results are consistent with the study done by Chu and Patil who reported insignificant differences between MPP and DPP for maxillary incisors and a distal trend for the Cs.[14,25]

Table 4: Values showing the percentage ratio of papilla height to crown length sorted by tooth position and divided into mesial and distal groups

Tooth	Sample		Mean ± SD	Min	Max
Right C	100	MPP	40 ± 6	32	50
Right C	100	DPP	40 ± 6	33	50
Right LI	100	MPP	34 ± 7	24	47
Right LI	100	DPP	34 ± 7	25	47
Right CI	100	MPP	38 ± 5	32	46
Right CI	100	DPP	38 ± 5	33	46
Left CI	100	MPP	38 ± 5	33	46
Left CI	100	DPP	39 ± 4	32	46
Left LI	100	MPP	35 ± 7	26	47
Left LI	100	DPP	37 ± 6	26	47
Left C	100	MPP	40 ± 5	34	50
Left C	100	DPP	41 ± 5	37	50

RC, right canine; RLI, right lateral incisor; RCI, right central incisor; LCI, left central incisor; LLI, left lateral incisor; LC, left canine; MPP, mesial papilla proportion; DPP, distal papilla proportion; SD, standard deviation

Conclusion

The present study provided direct quantitative measurements and qualitative descriptive statistics of the relative position of the GZ in the maxillary anterior sextant and the interdental papilla location. The positioning of the gingival margin during periodontal, orthodontic, restorative, and orthognathic surgical therapy can be determined using this data. The knowledge and application of some numeric guidelines offer significant help during complex situations. These numericals used in conjunction with other objective and subjective parameters aid the clinician in placing the gingival contours during surgery. Soft tissue dental esthetics management and success are always based on a careful planning of the operation. Incorrect placement of gingival margins not only results in pink esthetic failure but also affects the success of restorative procedure done. Hence, a proper interdisciplinary approach is necessary for the overall esthetic success.

Presentation

This original study won the first prize as a paper presentation titled "A quantitative spatial displacement of GZ and the mathematical expression of the interdental papilla location in the maxillary anterior dentition" at the 41st Karnataka State Dental Conference, Madikeri, Coorg, Karnataka, India, on November 22, 2014.

Pink Esthetics

Evaluation of GZ and the mathematical expression of interdental papilla location in the maxillary esthetic zone.

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