Gingival Zenith - A Critical Factor in Smile Design and Fixed Prosthodontics

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Abstract: Background & objectives: Knowledge of the gingival zenith (GZ) of the maxillary anterior teeth can be clinically applied to re-establish the proper gingival contour of the maxillary anterior teeth during esthetic anterior oral rehabilitation and smile designing. The purpose of this study was to evaluate gingival zenith (GZ) of each individual maxillary anterior tooth and their relative gingival zenith level. Method: A digital caliper was used to measure the gingival zenith of the maxillary anterior teeth from left canine to right canine on casts made from 30 young individuals without any dental deformity. The highest point on gingival margin of all maxillary anterior teeth was marked. Distance of this gingival zenith from the respective vertical bisector of each tooth was calculated. Also, the digital caliper was used to measure the distance of gingival zenith of the lateral incisors from a line connecting gingival zenith of maxillary central incisor and canine. Results: Significant difference exists between the gingival zenith of maxillary central incisors, lateral incisors and canines. Conclusion: Gingival zenith of maxillary incisors is distally placed whereas for canine it coincides with vertical bisector. Gingival zenith of lateral incisor is incisal to that of central incisor and canine. [Hitendra S NJIRM 2016; 7(4): 113-116]

Key Words: Gingival zenith, crown margin, smile design, esthetics, contour.

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Introduction: Smile dynamics are complex. Multiple factors play a role in establishing a beautiful smile and gingival esthetics is one of them. Beautiful restorations surrounded by unattractive gingival tissues can have a negative impact on a smile.

Gingival health is among the first fundamental esthetic objectives during treatment planning; it is also essential to consider gingival morphology and contour.[1]

Gingival zenith is the most apical point of the free gingival margin of the periodontium. The appropriate placement of the gingival zenith is critical, as it helps to determine the desired inclination of the tooth in relation to the vertical axis.

The literature consists of differing information on where the gingival zenith is located from the vertical bisector of each individual maxillary anterior tooth and where it should be placed.[1,2,3] Also absent is significant objective information regarding the gingival levels of the lateral incisors relative to the gingival zenith of the adjacent central and canine under healthy conditions.

The purpose of this study was to evaluate:
(1) Gingival zenith (GZ) of each individual maxillary anterior tooth in mesio-distal direction;
(2) Gingival zenith level (GZL) of maxillary anterior teeth in apico-coronal direction.

The null hypothesis at the beginning of the study was that no significant difference exists in gingival zenith position and level of maxillary anterior teeth.

Methods: A total of 30 young adults; 15 males and 15 females within the age group of 21 to 30 years without any dental deformity or having history of any periodontal, surgical, or orthodontic treatment were randomly selected at College of Dental Sciences & Research Centre after taking ethical approval from the institute. Subjects were informed of the nature of the study and written informed consent was taken. Alginate impressions of the study group were taken using irreversible hydrocolloid impression material and were immediately poured with stone.

A digital caliper with a light emitting diode (LED) display was used to measure the sites of the anterior maxillary teeth from canine to canine. The device was calibrated prior to each reading. A magnifying lens was used to mark the sites precisely.

The highest point of the free gingival margin was marked on both right and left maxillary central incisors, lateral incisors and canines as shown in (Fig 1). The distance of the highest gingival margin position from the vertical bisector of the respective tooth was measured (Fig 2). This provided the mesio-distal position of gingival zenith from midline of each individual tooth.

Fig 1: Gingiva zenith marked on maxillary anteriors

Fig 2: Distance of gingival zenith of left lateral incisor from midline

A line connecting gingival zenith of maxillary central incisor and canine was drawn on both right and left sides. The digital caliper was used to measure the distance of gingival zenith of the lateral incisors from this line to provide relative gingival level of lateral incisor from adjacent central and canine in apico-coronal direction (Fig 3).

Result: Data were collected for 60 permanent maxillary anterior teeth (right and left) from 30 dental casts and statistically analysed. Level of significance was set at p=0.05. It was found that 81.67% central incisors had a distal gingival zenith from the vertical bisector, with a mean of 0.76 mm (Table 1) while 18.33% coincided with vertical bisector. In males, central incisors' gingival zenith was more distal with a mean value of 0.84 mm (Chart- 1) while in females it was distal from vertical bisector by 0.68 mm

Fig 3: Distance of gingival zenith of right lateral incisor from line connecting gingival zenith of central incisor and canine.

72% Lateral incisors showed a deviation of the gingival zenith by a mean of 0.64 mm (Table 1) while 30% coincided with vertical bisector. Mean distance of gingival zenith from vertical bisector was similar in males (0.64 mm) as well as females (0.63 mm) (Chart – 1).

In 78.3% of the canines, the gingival zenith was centralized along the long axis of the canine. However in remaining 22.7% individuals it was placed distally by mean value of 0.11 mm (Table 1).

The mean distance of the gingival zenith level of the lateral incisors in an apico-coronal direction relative to line joining the adjacent central and canine's gingival zenith was approximately 0.74 mm. (Table 1)

Table 1: Mean and SD for various parameters

		n	Mean	±SD
Deviation of Gingival zenith from vertical bisector	Central Incisor	60	0.76	0.50
	Lateral Incisor	60	0.64	0.51
	Canine	60	0.11	0.22
Gingival zenith Level of Lateral Incisor (mm)		60	0.74	0.52

Statistically significant difference (P<0.001) was found in the position of gingival zenith in maxillary central incisors, lateral incisors and canines by analysis of variance (ANOVA) as show in Table 2.

determine the statistical significance of difference between individual teeth Post Hoc test was done. It was found that statistically significant difference exists between the gingival zenith of canines and incisors (P<0.001). However, difference in the gingival zenith between central and lateral incisors was not statistically significant (P>0.05).

Table 2: ANOVA for Deviation in Gingival Zenith of Maxillary Anterior Teeth from Vertical Bisector

Sum of squares	df	Mean Square	F	P value
14.432	2	7.216	38.63	<0.001

Chart- 1: Comparison between Males and Females for above parameters.

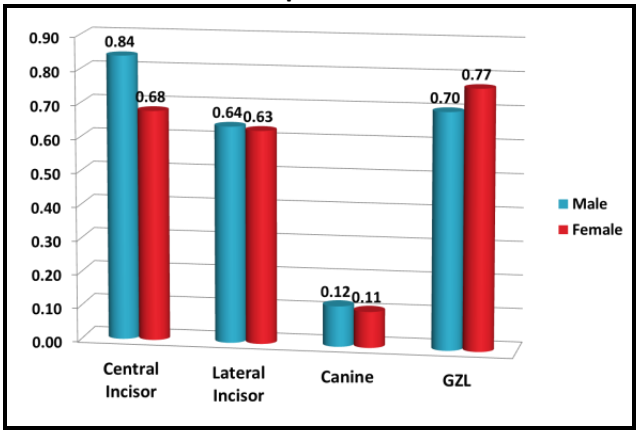

Table 3: Post Hoc Test for Intergroup Comparison

Between groups	Mean Difference	Std Err.	P	95% confidence Limit	
				Lower Limit	Upper Limit
CI v/s LI	0.05	0.79	0.288	0.07	0.32
CI v/s Canine	0.57	0.79	<0.001	0.46	0.85
LI v/s Canine	-0.52	0.79	<0.001	0.33	0.72

CI: Central Incisor LI: Lateral Incisor

Discussion: Elements involved in designing an esthetic smile have been profoundly discussed in the dental literature. The essentials of a smile involve the relationships among the teeth, the lip framework, and the gingival scaffold.[4] The lips form the frame of a smile and define the esthetic zone. The lip position during smiling determines the amount of gingival display. An investigation of periodontium visibility performed on 576 patients revealed that 43.57% of patients displayed gingiva during smile.[5]

Position of gingival zenith vertically as well as mesiodistally can significantly influence the esthetic appearance of a smile. Subsequently, knowing the gingival zenith position and level of anterior teeth enables the clinician to determine placement of gingival margin during tooth preparation for anterior oral rehabilitation and smile designing. It can also be used during wax-up and root carving for complete and partial dentures.

Magne and Belser[1] suggested that the gingival zenith was distal to the long axis of all the maxillary anterior teeth. Rufenacht[2] proposed that the gingival zenith was distally displaced on the central incisors and canines only. Chu et al[6] suggested that gingival zenith was distal to vertical bisector in all central incisors while it was centrally placed in canines. Charruel and colleagues[7] proposed that gingival zenith of canine was apical than those of incisors.

The findings of this study are similar for the maxillary central incisors but are in disagreement with those for lateral incisors and canines.

The differences in the results between this study and others may be attributed to various factors ranging from variations in methods; and size and ethnicity of the sample.

Further expansion of study with a large sample size and individuals from different ethnicities is required to be carried out.

Conclusion: Following conclusions were derived from the results of this study:-

1) Significant difference exists between the gingival zenith of maxillary central incisors, lateral incisors and canines.
2) Gingival zenith is distally placed from vertical bisector in both maxillary central and lateral incisors.
3) Gingival zenith is centrally placed along the vertical bisector in maxillary canines.
4) Gingival zenith of maxillary lateral incisors is occlusally placed relative to the adjacent central incisor and canine.

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