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### RESEARCH ARTICLE

#### A CLINICAL STUDY OF ASSESSMENT OF GINGIVAL ELEMENTS IN SMILE DESIGNING.

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#### Manuscript Info

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#### Abstract

**Background:** This study aims to determine, evaluate and compare the gingival elements of six maxillary anterior teeth and to evaluate the amount of visibility of gingiva during natural and forced smiles of patients in designing an esthetic smile.

**Methods:** A total of 25 patients (13 females and 12 males) aged between 18 to 30 years, with healthy gingiva were included in this study. From maxillary casts, Gingival Zenith Position (GZP) dimensions medio-laterally from Vertical-Bisected-Midline (VBM) of each anterior tooth and GZP of the Lateral Incisor (GZL) apico-coronally from tangent line connecting GZPs of the adjacent teeth and the Gingival Line Angle (GLA) for both sides of midline were measured. From Clinical photographs, gingival visibility was evaluated according to the classification given by Liebert et al. for both natural smile and forced smile.

**Results:** The mean location of GZP of Central Incisor, Lateral Incisor & Canine showed distal deviation of 1mm, 0.4mm & 0.9mm respectively. The mean GZL apical-coronally relative to the gingival tangential zenith line joining adjacent teeth was approximately 1 mm. The asymmetry quantified of GLA (left-right) difference is 1.65°. Smile Analysis revealed: Natural smile: C1:0%, C2:11%, C3:40% and C4:48%. Forced smile: C1:4%, C2:32%, C3:56% and C4:8%.

**Conclusion:** The findings of the current study might be used in conjunction with other objectives and subjective parameters to aid the clinician in making surgical template used to carry out periodontal corrections and in interdisciplinary management of anterior aesthetics.

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**Introduction:-**

Esthetics is a major concern for both practitioners and patients in dentistry and smile design is an inseparable component of dentofacial esthetics, where gingival component plays an important role. The appearance of gingival tissues plays an important role in the esthetics of the maxillary anterior teeth and the abnormalities in symmetry and contour can significantly affect the harmony of the natural or prosthetically restored dentition. Gingival morphology, contour and visibility play important role in a beautiful smile and are among the first fundamental esthetic objectives during treatment planning. They are also essential to consider prior to the final decision about the prosthodontic esthetic treatment. The ideal gingival architecture has been described as one that consists of knife-edged gingival margins tightly adapted to the teeth, interdental grooves, and cone-shaped interdental papilla. The amount of gingival exposure depends on the position of the smile line which is a curve that passes through the incisal margins of the maxillary incisors and canines making an arch. So, the purpose of this study was to determine, evaluate and compare the gingival elements of six maxillary anterior teeth and to evaluate the amount of visibility of gingiva during natural smile and forced smile in the patients to design an esthetic smile.

**Materials and Methods:-**

A sample population of 25 patients (13 females, 12 males) with healthy gingival tissue (6 thick and 19 thin gingival phenotypes) was studied. The patients, who ranged in age from 18 to 30 years (mean 27.7 years), were in good systemic health. Criteria for inclusion in the sample population were non restored maxillary anterior teeth, those with no anterior crowding or spacing, and teeth with no visible signs of excessive incisal attrition, gingival recession, gingival overgrowth, or altered passive eruption. Patients having fixed, removable prosthesis were excluded from the study because that might have an effect on esthetics and periodontal health.

Alginate impressions of the study group were made using irreversible hydrocolloid impression material and were immediately poured with stone. A six-inch digital calipers with LED display (i.e., graduations: 0.01 mm, accuracy: 0.02 mm, repeatability: 0.01 mm) were used to measure the sites of the anterior maxillary teeth from canine to canine. To define the VBM of each clinical crown, the tooth width was measured at two reference points. The proximal Incisal Contact Area Position (ICAP) and the Apical Contact Area Position (ACAP) served as the reference points. Each width was divided in half, and the center points were marked. Center points were extended to a line toward the gingival aspect of the clinical crown to define the VBM. The highest point of the free gingival margin was marked. The distance of the highest gingival margin position to the VBM was measured along the VBM of central incisors, lateral incisors, and canines to obtain the GZP in a medial-lateral direction. A gingival line (i.e., a line joining the tangents of the gingival zeniths of the central incisor and canine) was drawn. The distance of the highest point on the contour of gingival margin for the lateral incisor was measured from the gingival line to obtain the GZL in an apical-coronal direction of the lateral incisors relative to the adjacent central and canine gingival zenith points. This gingival line marked created an angle with the respective gingival zeniths of both left and right sides. Since the maxillary casts were a 3-dimensional structure, the measurement of the same was done by using a flexible protractor to get the exact angle of each zenith on both the sides, respectively. The highly sensitive photographic method was avoided as it converts the cast into a 2-dimensional structure and flattens the relation of each gingival line respectively. The gingival line angle on the left were noted as GLA (L) and right gingival angle were noted as GLA (R) and finally, the distance between the gingival zenith of lateral incisor and gingival line as LID. The lateral incisor's relationship to the gingival line was evaluated and the readings were noted as LID measurements. Positive values of the lateral incisor were coronal to the gingival line, whereas negative values were apical to gingival line. Statistical analyses were performed by independent sample *t*-tests and paired samples correlations ( $\alpha = 0.05$ ). The different gingival line angle for the right as well as left side was evaluated respectively using ANOVA test. The obtained data were then statistically calculated.

For evaluation of smile line, patients were photographed. The headrest was aligned to allow proper positioning of the head in Frankfort horizontal plane to assure optimal angulation. Two different pictures were taken of each participant: One during natural smile and another during forced smile. The amount of gingival visibility during natural and forced smile was determined from the pictures. The pictures were standardized as per Liebert et al., by positioning the head in the Frankfort horizontal plane and taking the picture from distance of 30 cm so as to include the lateral commissures of the mouth, the teeth, gingiva, and the philtrum of the upper lip. The smile line was analyzed according to the following classification:[1]

**Class 1:- Very High Smile Line:** More than 2 mm of marginal gingiva visible or more than 2 mm apical to the cemento-enamel junction visible for the reduced but healthy periodontium.

**Class 2:- High Smile Line:** Between 0 and 2 mm of marginal gingiva visible or between 0 and 2 mm apical to the cemento-enamel junction visible for the reduced but healthy periodontium.

**Class 3:- Average Smile Line:** Gingival embrasures only visible.

**Class 4:- Low Smile Line:** Gingival embrasures and cemento-enamel junctions not visible.

**Table 1:-** Distance of the gingival zenith position (mm) distal to the vertical bisected midline of the clinical crown along the long axis, sorted by tooth position and tooth groups:

Variables	Side	N	Mean	Min	Max
Central Incisor	Right	25	1.1 ± 0.18	0.8	1.3
	Left	25	1.1 ± 0.19	0.9	1.5
Lateral Incisor	Right	25	0.4 ± 0.23	0.1	0.7
	Left	25	0.3 ± 0.22	0	0.6
Canine	Right	25	0.9 ± 0.45	0	1.3
	Left	25	0.9 ± 0.46	0.1	1.3

**Table 2:-** Distance of the gingival zenith level (mm) of the Lateral incisors (LI) in an apical-coronal direction relative to the gingival line, joining the tangents of the gingival zenith Position of the adjacent central incisor and canine teeth.

Variables	Side	N	Mean	Min	Max
LATERAL INCISOR	RIGHT	25	0.96 ± 0.16	0.8	1.3
	LEFT	25	0.99 ± 0.19	0.8	1.3

**Table 3:-** The angle formed between the gingival line and maxillary midline (GLA)

Parameters	N	Mean	SD
GLA (R)°	25	84.61	5.48
GLA (L)°	25	86.7	4.29
L-R (GLA)°	25	1.65	4.14

Smile Type	C1(%)	C2 (%)	C3 (%)	C4 (%)	Total (%)
Natural	0	3 (12)	10 (40)	12 (48)	25 (100)
Forced	1 (4)	8 (32)	14 (56)	2 (8)	25 (100)

**Table 4:-**The frequency distribution of the study population during natural and forced smiles:

Smile Type	C1(%)	C2 (%)	C3 (%)	C4 (%)	Total (%)
Male	0	3 (12)	4 (16)	5 (20)	12 (48)
Female	0	3 (12)	4 (16)	6 (24)	13 (52)

**The frequency distribution of the study population according to gender during natural smile:**

**The frequency distribution of the study population according to gender during forced smile:**

Smile Type	C1(%)	C2 (%)	C3 (%)	C4 (%)	Total (%)
Male	0	4 (16)	5 (20)	3 (12)	12 (48)
Female	0	4 (16)	6 (24)	3 (12)	13 (52)

## Results:-

The sample of the present study was composed of 13 women and 12 men aged 18 to 30 years. The mean location of the GZP to the VBM of the clinical crown of central incisors, lateral incisors, and canines were located distally at 1.1, 0.4, and 0.9 mm, respectively. Table 1 shows the descriptive values of GZP distances to the VBM of clinical crowns of the maxillary anterior dentition. The mean distance of the contour of the gingival margin in an apico-coronal direction of the lateral incisors (GZL) relative to the gingival line joining the tangent of the adjacent central and canine GZPs was approximately 1 mm. The range of values measured was 0 to 1.5 mm [Table 2]. The GZL was differentiated into apical to GL, on GL, coronal to GL (0-1mm), and >1 mm from the GL and obtained as 7%, 17%, 49% & 27% respectively [Table 2]. The mean and standard deviation of the line angles was calculated [Table 3]. Smile analysis revealed: Natural smile: C1:0%, C2:11%, C3:40% and C4:48%. Forced smile: C1:4%, C2:32%,

C3:56% and C4:8%. Class 4 was the most frequent for natural smile (48%) and Class 3 was the most frequent for forced smile (56%). And also results showed that high and very high smile line was found more in women than in men.

### Discussion:-

Elements involved in designing an esthetic smile have been profoundly discussed in the dental literature.<sup>1,2</sup> The appearance of gingival tissues plays an important role in the esthetics of the maxillary anterior teeth and the abnormalities in symmetry and contour can significantly affect the harmony of the natural or prosthetically restored dentition. Gingival morphology, contour and visibility play important role in a beautiful smile and are among the first fundamental esthetic objectives during treatment planning. They are also essential to consider prior to the final decision about the esthetic treatment.<sup>3</sup> Kokich suggested that the relationship of the gingival margins of the six maxillary anterior teeth plays an important role in the esthetic appearance of the crowns.<sup>4</sup> Details such as the GZP, the most apical point of the free gingival margin of the periodontium, and the GZL of the lateral incisor relative to the central incisors and canine teeth can significantly influence the esthetic appearance of a smile. The appropriate placement of the gingival zenith is critical, as it helps to determine the desired axial inclination of the tooth by maneuvering the line angle of the tooth vertical axis. Subsequently, knowing the GZP of each maxillary anterior tooth from the VBM as well as the GZL of the lateral incisors can help facilitate a reference point during esthetic periodontal plastic surgery procedures.<sup>5</sup> It was found that the zenith of maxillary canine is apical to the zenith of central incisors because GLA measurements were  $<90^\circ$  and the gingival zenith of lateral incisor is frequently below the gingival line (76%). The data also showed gingival asymmetry of the gingival lines with right sides higher than left sides, which is similar to craniofacial or dental studies done earlier.<sup>6</sup> Very few studies have been done in which the visibility of gingival margin has been determined. Crispin and Watson reported that upper lateral incisor was the most common visible tooth during his evaluation of 425 dental school students. Gingival margin was visible in 66% of the students during normal smile. However, during forced smile, 84% of the subjects displayed the gingival margin. But one of the drawbacks of this study was that it did not include the presence of interproximal papilla and neither the influence of age, gender on the subjects examined. However, present study included presence of interproximal papilla in Class 3, i.e., average smile line group (Class 3) allowed only the detection of interproximal papilla, not involving the gingival margin.<sup>7</sup> Jensen *et al.* reported that women had higher smile line in comparison to males.<sup>8</sup> Tijan *et al.* who did a study on 20- to 30-year-old students also reported that high and very high smile line was found more in women (14% and 75%) than in men (7% and 63%).<sup>9</sup> Wichmann M in his study said that there were no significant differences in visibility of gingival margins between younger (Average age 25 years) and older subjects (Average age 55 years).<sup>10</sup>

### Conclusion:-

The mean location of the GZP from the VBM of the clinical crown of all the anterior teeth showed distal deviation. The asymmetry quantified of GLA (left-right) difference is  $1.65^\circ$ . The GZL was differentiated into apical to GL, on GL, coronal to GL (0-1mm), and  $>1$  mm from the GL and obtained as 7%, 17%, 49% & 27% respectively. Class 4 was the most frequent for natural smile (48%) and Class 3 was the most frequent for forced smile (56%). The findings of the current study might be used in conjunction with other objectives and subjective parameters to aid the clinician in placing the gingival contours during surgery and can be clinically applied to re-establish the proper intratooth GZPs of the maxillary anterior teeth during periodontal crown lengthening or root coverage procedures and these clinical parameters could be used for the most complex situations, like interdisciplinary management of anterior aesthetics. This can help in making surgical template used to carry out periodontal corrections.

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