Original article:

Relative position of gingival zenith in maxillary anterior teeth- a clinical appraisal

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Abstract:

Introduction: Our aim was to evaluate the position of gingival zenith relative to the midline in maxillary anterior teeth in attractive smiles.

Materials and Methodology: 240 sites in 20 subjects were evaluated. The vertically bisected midline (VBM) of the six anterior teeth were marked on diagnostic casts. The gingival zenith position (GZP) for each tooth was then marked on the same casts. The difference was evaluated and compared by subjecting the data to t-test.

Results: This study demonstrated that all central incisors displayed a distal GZP from the VBM, with a mean average of 0.9 mm. Lateral incisors showed a deviation of the gingival zenith by a mean of 0.5 mm. For canines, the mean distal deviation was 0.3mm.

Conclusion: Maxillary central incisors display GZP more distal to VBM than that of maxillary lateral incisors while canines have both mesial, distal as well as concurrent GZP. These data could be used as reference points during aesthetic anterior oral rehabilitation.

Keywords: Gingival zenith position, Maxillary anterior teeth, Aesthetics, Fixed dental prosthesis.

Introduction:

Attitudes toward the importance of our general appearance have shown rapid changes over the past decades. Differences have been found not only over time but also with respect to age, gender, and various groups of individuals. Whether the situation is similar regarding dental appearance does not seem to have been studied, even though interest in dental esthetics has increased rapidly during the last few decades among both patients and dentists. To create a natural facial and dental appearance has become an important task in prosthodontics and in restorative dentistry. New materials and clinical methods have given dentists a potential for improving the dental appearance of their patients.1

The attractiveness of a smile is characterized by numerous factors involving both the teeth and the surrounding soft tissues. These factors have to be taken into consideration during tooth restoration. The gingival zenith (GZ) is defined as the most apical point of the marginal gingival scallop;2 however, its quantitative orientation in the mesio-distal (MD) directions has not been reported. The GZP has always been an important component of a beautiful smile. The literature primarily consists of conjecture and has presented differing information on where the gingival
zenith position (GZP) is located from the vertical bisected midline (VBM) axis of each individual maxillary anterior tooth and where it should be placed.3,4

Before any type of esthetic treatment, the esthetic evaluation always starts with the smile analysis. The essentials of a smile involve the relationships among the teeth, the lip framework, and the gingival scaffold. To predict the final esthetic result and achieve optimum results in gingival contour rehabilitation (crown lengthening, implant and orthodontic therapy), it is important to take gingival contours into account during treatment planning.

Materials and methods:
A sample population of 20 patients (13 females, 7 males) with healthy gingival tissue was studied. The patients, who ranged in age from 18 to 25 years, were in good systemic health. Criteria for the exclusion were: evidence of gingival hyperplasia, inflammation, altered passive eruption, attachment loss, gingival recession, periodontal surgery, prior visible composite resin restorations on the facial surfaces of the teeth, prior traumatic injury or occlusal wear into the dentin on maxillary anterior teeth, dental malocclusion, or prior orthodontic treatment.5

Maxillary impressions of the study group were made using irreversible hydrocolloid impression material (Tropicalgin, Zhermack, Germany) and were immediately poured in dental stone (Kalstone, Kalabhai, India). Figure 1. A digital caliper with a light emitting diode (LED) display was used to measure 120 sites of the anterior maxillary teeth from canine to canine. Six-inch digital calipers with LED display were used for measurement. The caliper was calibrated prior to each measurement. To define the VBM of each clinical crown, the tooth width was measured at two reference points. The proximal incisal contact area position and the apical contact area position 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 (figure 2).

The highest point of the free gingival margin was marked. A vertical line was made upto the incisal edge of the anterior teeth. 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 (figure 3).

The distance between these two points was measured using the digital calipers (figure 4). A positive reading was recorded if the zenith position was located distally to the midline. A negative reading was recorded if the position was mesially to the midline.

Statistical analyses were performed by independent sample t-tests and paired samples correlations. p value < 0.05 was considered statistically significant. To achieve a high degree of data accuracy for each anterior tooth position, data were collected and calculated for each tooth position separately, and subsequently paired by tooth groups.

Results:
One hundred percent of central incisors displayed a distal GZP from the VBM For lateral incisors, 88% of the population showed a distal displacement of GZP from the VBM, and 12% showed that the GZP was concurrent and centralized along the vertical axis of the tooth. Only 20% canines had a distal GZP than VBM, 20% had co-inciding VBM and GZP while 60% had a mesial GZP compared to VBM. The mean distal distances of the GZP to the VBM of the clinical
crown of central incisors, lateral incisors, and canines were 0.95, 0.53, and 0.37 mm, respectively.

Table 1 shows the descriptive values of GZP distances to the VBM of clinical crowns of the. These trends between the tooth groups were observed but were statistically significant ($p < 0.05$).

<table>
<thead>
<tr>
<th>Gingival zenith position</th>
<th>N</th>
<th>Group</th>
<th>Mean ± sd</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>#11</td>
<td>20</td>
<td>CI</td>
<td>0.95</td>
<td>0.39</td>
<td>1.18</td>
</tr>
<tr>
<td>#21</td>
<td>20</td>
<td>CI</td>
<td>0.95</td>
<td>0.40</td>
<td>1.17</td>
</tr>
<tr>
<td>#12</td>
<td>20</td>
<td>LI</td>
<td>0.53</td>
<td>0.33</td>
<td>0.84</td>
</tr>
<tr>
<td>#22</td>
<td>20</td>
<td>LI</td>
<td>0.53</td>
<td>0</td>
<td>0.80</td>
</tr>
<tr>
<td>#13</td>
<td>20</td>
<td>C</td>
<td>0.37</td>
<td>-0.33</td>
<td>1.1</td>
</tr>
<tr>
<td>#23</td>
<td>20</td>
<td>C</td>
<td>0.37</td>
<td>-0.36</td>
<td>1.1</td>
</tr>
</tbody>
</table>

**Discussion:**
Recent studies on cosmetic dentistry assert that the proportion and shape of the teeth, proximal contact areas, and gingival zenith, among other factors, are desirable characteristics of an attractive smile. To aid treatment planning, several studies have examined the relationship between dentofacial characteristics and smile attractiveness, looking for the threshold that demonstrates the degree of acceptance of alterations in esthetic parameters. Although some studies have associated dentofacial features with smile attractiveness, to the best of our knowledge, there are no studies investigating gingival zenith positions in the Indian population.

Gingival esthetics has always been an important component of a beautiful smile. Beautiful restorations surrounded by unattractive gingival tissues can negatively 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. Framing the teeth, within the confines of the gingival architecture, has a tremendous impact on the aesthetics of the smile. A gummy smile is as unaesthetic as a patient with severe recession. The impact on the beauty of a smile from an uneven gingival contour height can be dramatic and although the position of the zenith of the gingival tissue seems like a small detail, it can greatly influence the axial inclination and emergence profile of the teeth. The position of the zenith will help create the desired axial inclination of the tooth by changing the line angle position of the long axis of the tooth. The correct location of the gingival zenith is also important when treatment planning the correction of rotated anterior teeth by tooth reduction and jacket crowns. In case of missing anterior teeth restored with dental implants, use of narrow diameter implant is associated with maintenance and stability of the gingival zenith position leading to prevention of unaesthetic black triangles showing after prosthodontic rehabilitation is completed.
The gingival zenith as such has a remarkable influence on the morphology of the planned restoration affects other objective criteria, including the balance of gingival levels (too inferior or superior), the tooth axis (too distal or mesial), the tooth dimension (too inferior or superior), and the tooth form (triangular becomes ovoid if too inferior). Without the control of the gingival zenith, the clinician’s ability to define dental implant esthetics is vastly diminished. At least four factors affect the gingival zenith. One is, of course, the relative location of the tissues to the planned gingival zenith. Second is the depth of the dental implant placement. Third is the response of the buccal bone and mucosa to the implant procedure and components. The fourth is the prosthodontic management of the gingival zenith architecture.\(^9\)

Dental esthetics is not all about the white esthetics i.e., tooth, but pink esthetics, i.e., gingiva also is of indispensable importance, as both are incomplete if not in harmony.\(^{10}\) The findings of the current study would aid the clinician in the most complex situations demanding high aesthetic accuracy like placing the gingival contours in prosthetic or implant restorations, during cosmetic periodontal surgery such as crown lengthening procedures and gingivoplasty for esthetic reconstruction, and also help in the construction of surgical templates. Gingival Zenith position can act as reference points, in conjunction with other subjective and objective aesthetic parameters to aid in diagnosis, treatment planning, and in reconstructing a natural smile.

**Conclusion:**
The mean location of the GZP from the VBM of the clinical crown of central incisors, lateral incisors, and canines was about 0.95 mm, 0.53 mm distally, and 0.37 mm, respectively. The findings of the current study can be clinically applied to reestablish the proper intratooth GZPs of the maxillary anterior teeth during fixed dental prosthetic treatment, periodontal crown lengthening or root coverage procedures, and also during fabricating anterior restorations in the dental laboratory. Understanding the dentogingival complex would also aid the clinicians to give a more aesthetic fixed dental treatment outcome by an interdisciplinary approach.  

**Conflict of interest:** none
References: