INTRODUCTION

Driven by increased demand for cosmetic dentistry during the last decade, facial esthetics and the desire of patients to improve their appearance have grown in importance.1 Gingival display and the relative relationship of the upper and lower anterior teeth have an absolute effect on smile esthetics.2 It has been stated that the esthetically ideal amount of visible gingiva during smiling is about 1 mm, although 2 to 3 mm of gingival display might be esthetically acceptable.3 The amount of esthetically acceptable gingival display during smiling can vary widely, but the relationship between gingival display and incisor show at rest is important.4

ABSTRACT

Objective: To determine the frequency of gingival display during smiling and to compare biometric measurements in subjects with and without gingival display.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Prosthodontics, Dr. Ishrat-ul-Idab Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, from October 2012 to March 2013.

Methodology: A total of 275 subjects (121 men and 154 women) were included in this study. The age of the participants ranged between 21 and 65 years. Measurements were carried out using digital caliper. For each participant, the gingival display was judged as either visible or not. The amounts of horizontal and vertical overlap of anterior teeth were measured using a digital caliper. Gender differences in these parameters and the relationship between subjects showing gingival display when smiling and the two intraoral dental biometric measurements were determined. Statistical analysis of data was performed using SPSS version 17.0 software. The mean scores for gender were calculated and a Student’s t-test was used to identify significant differences between both groups. Significant level was set to 0.05.

Results: A relatively small percentage of the subjects (37.8%) displayed gingiva when smiling. More women significantly displayed gingiva when smiling than men, with a 2:1 female: male ratio. Women had significantly (p=0.001) more horizontal overlap (3.34 ± 1.45 mm) than men (2.90 ± 1.44 mm), although no significant gender difference were found in vertical overlap. Subjects with gingival display had significantly (p < 0.05) more horizontal (3.49 ± 1.36 mm) and vertical (3.26 ± 1.47 mm) overlap of anterior teeth compared to those who did not display gingiva when smiling.

Conclusion: Significantly more women displayed gingiva in smiling. Women had significantly more horizontal overlap than men. No gender differences were recorded between vertical overlap. Subjects who displayed gingiva when smiling had more horizontal and vertical overlap of anterior teeth.

smile. The mean horizontal and vertical overlaps of anterior teeth in subjects who displayed gingiva when smiling were significantly higher than those who did not display gingiva. Significant gender differences in the horizontal and vertical overlap of anterior teeth has also been reported in some studies, whereas other studies showed no gender predilection.

Decision about restorative margin placement are, however, directly related, among other parameters, to the amount of gingival display at different lip positions, such as during speech, exaggerated smile and the rest position of the mandible.

The identification of any possible correlations between horizontal and vertical overlap and gingival display is of interest as they could be used as guidelines for esthetic considerations in prosthetic restorations.

This study has been done on western population but there is no local data available on this topic. This study would help in developing strategies to maintain esthetic element during prosthodontic management in the Pakistani population.

The purpose of this study was to determine the frequency of gingival display during smiling and to compare intraoral biometric measurements (horizontal and vertical overlap) in subjects with and without gingival display in the Pakistani population.

**METHODOLOGY**

This was a cross-sectional study conducted from October 2012 to March 2013 at the Department of Prosthodontics, Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, Pakistan.

The selected subjects had maxillary and mandibular anterior teeth present without caries, tooth surface loss, gingival and periodontal disease, crowding, interdental spacing, anterior restoration, fracture and facial asymmetry. Subjects with a history of congenital anomalies, orthodontic treatment, oral and maxillofacial surgery, lip trauma and neurological disorder were excluded.

After taking consent, measurements were performed with the subjects seated in a dental chair with the head and back in an upright position. Cheek retractors were used to facilitate using the caliper intraorally so that the cheeks and lips could not interfere with accuracy of the measurements.

Measurements were carried out using an electronic digital caliper. The measuring gauge had a resolution of 0.01 mm, and measured dimensions were recorded to this degree of accuracy. The caliper has two edges, external and internal. External edges were used to measure the length of the mandibular right central incisor. Internal edges were used to measure the displayed length of the mandibular right central incisor and the horizontal overlap of anterior teeth between the maxillary and mandibular right central incisor.

Gingival display was noted by asking each participant for a maximum smile. The gingival displayed was recorded and it was judged as either visible or not.

The horizontal overlap of the anterior teeth was measured by inserting the internal edges of the caliper between the incisal edges of the upper and lower right central incisors at the incisal edge point of maximum maxillary right central incisor length, and horizontally to the opposing labial surface of the mandibular right central incisor. For participants with reverse occlusal relationships (class-III cases), the measurements were performed from the incisal edge of the mandibular right central incisor and horizontally to the labial surface of the opposing maxillary right central incisor. When there were no horizontal and/or vertical overlaps of anterior teeth (edge to edge), the measurements were recorded as zero.

The vertical overlap of the anterior teeth were calculated by subtracting the displayed portions of the mandibular right central incisor in maximum intercuspation from the actual vertical length measured on the labial surface of these teeth. For participants with reverse occlusal relationships (class-III cases), the measurements were performed on the labial surfaces of maxillary right central incisors.

For each dimension, three measurements were made, and the means were calculated.

Statistical Package for Social Sciences (SPSS), version 17 software was used for the analyses of data. A chi-square test was performed to determine whether there were differences in gingival display during maximum smiling between men and women. An independent sample t-test was performed to determine whether there were gender differences in the horizontal and vertical overlap of anterior teeth.

All recorded data were analyzed using a t-test, which was performed to reveal statistically significant differences in mean values of the parameters evaluated (amount of horizontal and vertical overlaps of anterior teeth). Ninety-five percent confidence intervals about the mean were constructed for differences between men and women, and between gingival display and non-gingival display participants. The mean scores were calculated, and a t-test was used to identify significant differences at a level of 5%.

**RESULTS**

Two hundred and seventy five (275) participants (121 men, 154 women) were included in this study. The age of the participants ranged between 21 and 65 years with a mean of 33.01 ± 12.26 years. The mean age of men
was higher than that of women. Participants who displayed gingiva were approximately two and a half years younger than those who did not display gingiva with smiling.

Table I shows the gender distribution of participants according to the gingival display when smiling. Statistically significant differences were recorded between subjects with displayed gingiva (37.8%) compared to those who did not display gingiva (62.2%) when smiling (p < 0.001). In addition, more women were found to significantly display gingiva when maximum smiling as compared to male counterparts (p < 0.001); however, no gender differences were recorded between male and female subjects who did not display gingiva with smiling.

Table II shows gender difference between the intraoral parameters: horizontal and vertical overlap of anterior teeth. The mean horizontal (overjet) and vertical (overbite) overlap of anterior teeth were 3.15 ± 1.46 mm and 3.03 ± 1.51 mm, respectively. Female participants exhibited significantly more horizontal overlap than did male participants (p=0.012), although no significant gender difference were found in vertical overlap.

Table III shows subjects who displayed gingiva during smiling had significantly more horizontal and vertical overlaps compared with those who did not display gingiva during smiling. Females who did not display gingiva when smiling had significantly more horizontal overlap than did male participants (p=0.003), however; there were no gender differences in the horizontal overlap of subjects who displayed gingiva during maximum smiling.

Male subjects who displayed gingiva during maximum smiling had significantly more vertical overlap as compared to female subjects (p=0.001); however, there were no gender differences in the vertical overlap of subjects who did not display gingiva during smiling.

**DISCUSSION**

The present study was conducted to determine the frequency of gingival display during posed smile and to compare intraoral biometric measurements (horizontal and vertical overlap) in subjects with and without gingival display. The sample was representative of the Pakistani population who attended the study place for a period of 8 months. This study was focused on the gingival display during posed smile and the uniqueness of this study is the comparison of horizontal and vertical overlap in subjects with and without gingival display. The dental literature on this subject is non-existent, local data is also not available on this topic.

The results of this study have shown that more female participants displayed gingiva during maximum smiling compared to male participants. These results are in accordance with previous studies. Tjan et al. reported that 37% of male subjects displayed gingiva when smiling as compared to 80% of female subjects. Gingival display is generally compatible with pleasing facial esthetics in the eye of the public. Peck et al. reported that excessive gingival display during smiling is rare among men. Some amount of gingival display is

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**Table I:** Gender distribution of subjects according to gingival display with maximum smiling.

<table>
<thead>
<tr>
<th></th>
<th>Gingival display (n=121)</th>
<th>Nongingival display (n=154)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%)</td>
<td>35 (12.7)</td>
<td>86 (31.3)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td></td>
<td>0.068</td>
</tr>
<tr>
<td>Total (n=275)</td>
<td>104 (37.8)</td>
<td>171 (62.2)</td>
<td></td>
</tr>
</tbody>
</table>

**Table II:** Gender differences of horizontal and vertical overlap of the anterior teeth.

<table>
<thead>
<tr>
<th>Intraoral esthetic dental parameters</th>
<th>Male (n=121)</th>
<th>Female (n=154)</th>
<th>Total (n=275)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlap of anterior teeth</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>t-test</td>
</tr>
<tr>
<td></td>
<td>H (mm)</td>
<td>V (mm)</td>
<td></td>
<td>p-value</td>
</tr>
<tr>
<td></td>
<td>2.90 (1.44)</td>
<td>3.07 (1.64)</td>
<td></td>
<td>2.53</td>
</tr>
<tr>
<td></td>
<td>3.34 (1.45)</td>
<td>3.00 (1.40)</td>
<td></td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>3.15 (1.46)</td>
<td>3.03 (1.51)</td>
<td></td>
<td>0.068</td>
</tr>
</tbody>
</table>

SD = Standard deviation; H = Horizontal; V = Vertical; n = Number.

**Table III:** Relationship of horizontal and vertical overlap of the anterior teeth to the gingival display with maximum smiling.

<table>
<thead>
<tr>
<th></th>
<th>Gingival display</th>
<th>Nongingival display</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=35)</td>
<td>Female (n=69)</td>
<td>Total (n=104)</td>
</tr>
<tr>
<td>Horizontal overlap</td>
<td>Mean</td>
<td>SD</td>
<td>t-test</td>
</tr>
<tr>
<td></td>
<td>3.62</td>
<td>1.46</td>
<td>0.66 (p=0.50)</td>
</tr>
<tr>
<td></td>
<td>3.43</td>
<td>1.31</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td>3.49</td>
<td>1.33</td>
<td>1.36</td>
</tr>
</tbody>
</table>

|                  | Male (n=86)      | Female (n=85)       | Total (n=171) |
|                  | Mean             | SD                  | t-test       |
|                  | 2.60             | 1.33                | 1.36         | 0.002        |
|                  | 3.27             | 1.56                | 1.36         | 0.002        |
|                  | 2.94             | 1.49                | 1.36         | 0.002        |

|                  | Nongingival display | Male (n=104) | Female (n=171) | Total (n=275) | Significance |
|                  | Mean               | SD            | t-test       |
| Horizontal overlap | Mean       | 3.26          | 2.74         | 2.89          | 1.97         |
|                   | 3.27             | 3.27          | 3.27         | 3.27          | 1.97         |

SD = Standard deviation; n = Number.
certainly acceptable and, in many cases, is even esthetic and youthful appearing. Up to 3 mm of gingival exposure above the cervical margins of the maxillary teeth is esthetically acceptable. Gingival display in excess of 3 mm is considered to be excessive, requiring correction by orthodontic or surgical intervention to avoid visual tension. Men generally have longer maxillary lips than females, leading to an average maxillary tooth display of 1.91 mm for men and 3.40 mm for women. Consequently, gender differences account for women displaying nearly twice the amount of maxillary teeth as do men. Horizontal and vertical overlap of anterior teeth not only have a close relationship to esthetic perceptions, but they can differ significantly among races and between genders. In this study, the mean horizontal (overjet) and vertical (overbite) overlap of anterior teeth were 3.15 and 3.03 mm, respectively, although female subjects had significantly more horizontal overlap than did male subjects. In this study, no significant gender differences were found in vertical overlap, which is in accordance with previous studies. Peck et al. reported a link between horizontal and vertical overlap in patients with significant gingival display with maximum smile. They found that subjects with excessive gingival display had mean overjets of 1.5 mm and overbite of 1.0 mm larger values in both dimensions compared to the sample who had no gingival display with smiling. In this study, it was found that the mean horizontal and vertical overlaps of anterior teeth in subjects who displayed gingiva when smiling were significantly higher than those who did not display gingiva, which is in accordance with previous studies.

Horizontal and vertical overlap depends on the incisingingival length of the anterior teeth (both maxillary and mandibular), the shape of the arches, and angulations of the teeth in the sagittal plane. In ideal circumstances, the maxillary central incisors are 12 mm long, perfectly aligned, and the arch form is within the norm, with the mandibular central incisor 10 mm long. In this case, the vertical overlap and horizontal overlap were 4 and 2 mm, respectively. The current interest in soft tissue dental esthetics has emerged in part due to a more critical analysis of the esthetic interrelationship between gingival tissues and teeth.

The result of this study can be helpful in the esthetic management of gingival abnormalities, especially for patients with gingival display when smiling. If implants are being considered as part of the prosthodontic treatment plan, data of this nature may aid in the selection of potential sites for implant placement. In this way, the prosthetic teeth can be centered over implants to improve biomechanics and enhance esthetic outcomes.

CONCLUSION

Significantly more female participants were found to display gingiva during maximum smiles, compared with their male counterparts (p < 0.001). Female subjects had significantly (p=0.01) more horizontal overlap (3.34 ± 1.45 mm) than did male subjects (2.90 ± 1.44 mm), although no significant gender differences were found in vertical overlaps. Subjects who displayed gingiva during a maximum smile had significantly (p=0.002) more horizontal (3.49 ± 1.36) and significantly (p=0.049) more vertical (3.26 ± 1.47) overlap of anterior teeth compared with subjects who did not show their gingival tissues when smiling.

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