Upper Lip Changes and Gingival Exposure on Smiling In Group With Class I Normal Occlusion.

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Abstract
Our objectives were to evaluate and quantify upper lip soft-tissue changes in the vertical dimensions both at rest and at maximum smile. Methods thirty three volunteers (15 men, 18 women) aged 18 to 23 (mean, 21.5 years) were recruited for this study. For each subject, 8 measurements of upper lip position and maxillary incisor crown height at rest and in maximum smile were recorded.
Results: A statistically significant sexual dimorphism was apparent in most of the measured variables. Relaxed external upper lip length was 1.8 mm shorter in the women than in the men. The mean maxillary central incisor length was 0.56 mm greater in the men than in the women. A low smile line was more prevalent in the women, The average smile is more prevalent in male than female.
Conclusions: Data from this study clearly indicate sexual dimorphisms in upper lip length, maxillary incisor display, and resting external upper lip length. Low smile patterns are more common among female patients, and also common among male patients while high smile are less common among female and male patients. The average smile is more prevalent in male than female.

Key words; gingival exposure, smile gingival, upper lips.

Introduction
The smile is a voluntary facial expression indicating happiness, pleasure, and greeting. Maxillary gingival exposure during smiling causes interest and concern among many dental practitioners and plastic surgeons. An excessive gingival display on smiling, referred to as “gummy smile,” “high lip line,” or “high smile line,” is often esthetically displeasing and considered undesirable (Ricketts, 1968; Singer, 1974; Jnzen, 1977; Tjan & Miller, 1984; Mack, 1996; Garber & Salama, 2000; Silberberg et al., 2009). According to Garber and Salama, the essentials of the esthetic smile involve the relationship between 3 primary components: teeth, lip framework, and gingival scaffold. Several etiologic factors have been suggested in the literature, including skeletal, gingival, and muscular factors that can contribute alone or in combination to this feature (Garber & Salama, 1996; Silberberg et al., 2009; Peck et al., 1992; McAlister et al., 1998; Hwang et al., 2009). Several treatment modalities have been proposed in the literature to diminish the gingival display on smiling. In patients with clinically short anterior tooth crowns, surgical crown lengthening or gingivectomy is recommended (Garber & Salama, 1996; Silberberg et al., 2009). In other patients, whose teeth crowns are proportionally balanced, but muscular hyperactivity is suspected, injection of botulinum toxin-A to the lip elevator muscles (Hwang et al., 2009; Polo, 2005; Polo 2008), or a lip repositioning procedure (Litton & Fouriner, 1979; Miskinyar, 1983; Ezquerra et al., 1999; Rosenblatt & Simon, 2006) is advocated.
In patients whose gingival display is excessive as a result of maxillary vertical excess, orthognathic surgery has been suggested (Garber & Salama, 1996; Ezquerra et al., 1999). Some soft-tissue surgical procedures, especially lip repositioning, lack wide scientific evidence and long-term follow-ups as do some other surgical procedures; they can lead to relapse and undesirable side effects such as scar contraction. The purposes of this study were to evaluate and quantify upper lip soft-tissue changes in the vertical dimensions at both rest and maximum smile in a group of sample with class I normal occlusion (Miron & Allon, 2012).

**Material and Methods**

The sample has been selected randomly from the students of Babylon university (college of medicine, college of dentistry and college of nursing). Out of 50 persons only 33 subjects were selected (18-23 years old). The sample was taken in terms of the following criteria:-

1. The sample was all of Iraqi Arab in origin.
2. No participants had undergone any maxillofacial surgery or anterior maxillary tooth prosthodontics rehabilitation.
3. No previous orthodontic treatment.
4. No extracted teeth up to the first molar.

The normal occlusion has been determined by the following criteria(Amasha, 2002; Uysal & Memili, 2005; Vitral et al., 2011; Scavone et al., 2008; Obaidi & Manar, 2007):

- **a)** Normal buccal segment relationship (class I molar relationship and class I canine relationship).
- **b)** Class I incisal relationship
- **c)** Normal overjet and overbite(2-4mm)
- **d)** Minor spacing or crowding.
- **e)** No crossbite (anteriorly and posteriorly).

To reach the maximum social smile position, each subject was requested to present his or her full smile a few times, and measurements were taken when the subject successfully repeated the full smile pattern. In addition, the age and sex of each subject were recorded. The measurements and the methods used to obtain these variables are as follows.

1. Performed both at rest and maximum smiling:
   - **a)** external upper lip length, the vertical measurement from the alar base of the nose (subnasale) to the inferior border of the upper lip (stomion superioris).
   - **b)** vermilion height, the vertical measurement from the superior border of the vermilion at the Cupid’s bow to the inferior border of the upper lip.
   - **c)** maxillary central incisor display, the vertical measurement from the inferior border of the upper lip to the incisal edge of the left central incisor.

2. Performed once in maximum smiling when applicable:
   - **a)** gingival display in maximum smiling, recorded in patients whose gingival display was noticed in the maximum smile.

Two consecutive trials were made in each subject before recording the measurement to verify the validity of the position. Measurement of hard-tissue landmarks by estimation over soft-tissue landmarks is a common and acceptable concept used in various measurements in medicine (e.g., the identification of nasion and porion with a facebow).

- **b)** Maxillary central incisor height, the vertical measurement of the clinical crown height of the maxillary left central incisor.

The measurement was made under direct vision at the center of the tooth. Smile pattern was classified according to the 3 categories defined by Tjan et al,(1984)
relating to the anterior maxillary tooth crown exposure at maximum smile: “low smile” displaying less than 75% of the clinical crown height of the maxillary anterior teeth, “average smile” revealing 75% to 100% of the maxillary anterior crown height, and “high smile” exposing the whole anterior maxillary crown height and a band of contiguous maxillary gingiva. Independent Student t tests were performed to assess differences between the sexes.

Results

Means and standard deviations, derived for all measured variables of the subjects, are reported with some statistical information in table I. Relaxed external upper lip length was 1.8 mm shorter in the women than in the men (P<0.05).

The mean maxillary central incisor display at rest was 0.42 mm greater in the women than in the men, it was not statistically significant. The upper vermilion comprised 35% to 42% of the external upper lip length. Although it was not statistically significant, the women tended to have a higher percentage of vermilion display relative to the men, table I. Central incisor clinical crown height was 0.56 mm shorter in the women compared with the men (P<0.05). The mean maxillary central incisor display at smiling was more in men (7.36 mm) than in women (5.71 mm). External upper lip length became shorter by about 23% at maximum smiling in both genders, table I. High smiles, with exposure of the entire maxillary incisors and a band of gingiva, were noticed in 12% of the study population and were more prevalent in men (14%) than in women (11%). Average smiles, noticed in 27% of the subjects, were more common in men (33%) than in women (22%). Low smiles were noticed in 61% of the subjects and were more than in women (67%) than men (53%). Table II summarizes the smile patterns by genders.

Table I gender differences of study parameters.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
<th>t test</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting external upper lip length (mm)</td>
<td>18.81</td>
<td>1.54</td>
<td>20.69</td>
<td>2.23</td>
<td>-2.64</td>
<td></td>
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<tr>
<td>Resting maxillary central incisor length (mm)</td>
<td>0.82</td>
<td>1.59</td>
<td>0.40</td>
<td>0.84</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Resting vermilion/external upper lip length ratio</td>
<td>0.42</td>
<td>0.06</td>
<td>0.35</td>
<td>0.10</td>
<td>2.54</td>
<td></td>
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<tr>
<td>Maxillary incisor height (mm)</td>
<td>9.10</td>
<td>0.64</td>
<td>9.66</td>
<td>0.30</td>
<td>-2.58</td>
<td></td>
</tr>
<tr>
<td>Smiling external upper lip length (mm)</td>
<td>14.51</td>
<td>2.14</td>
<td>15.92</td>
<td>1.73</td>
<td>-1.78</td>
<td></td>
</tr>
<tr>
<td>Smiling maxillary central incisor display (mm)</td>
<td>5.71</td>
<td>2.36</td>
<td>7.36</td>
<td>2.10</td>
<td>-1.84</td>
<td></td>
</tr>
<tr>
<td>Smiling/resting external upper lip length ratio</td>
<td>0.78</td>
<td>0.14</td>
<td>0.77</td>
<td>0.08</td>
<td>0.01</td>
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</table>

Table II Smile pattern by gender.

<table>
<thead>
<tr>
<th>Smile type</th>
<th>Female (%)</th>
<th>Male (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low smile</td>
<td>12 (67%)</td>
<td>8 (53%)</td>
<td>20 (61%)</td>
</tr>
<tr>
<td>Average smile</td>
<td>4 (22%)</td>
<td>5 (33%)</td>
<td>9 (27%)</td>
</tr>
<tr>
<td>High smile</td>
<td>2 (11%)</td>
<td>2 (14%)</td>
<td>4 (12%)</td>
</tr>
<tr>
<td>Total</td>
<td>18 (100%)</td>
<td>15 (100%)</td>
<td>33 (100%)</td>
</tr>
</tbody>
</table>

Discussion

Gingival and tooth exposure during smiling are challenging issues to many physicians, especially those who deal with smile esthetics. Overexposure of teeth and gingival tissues is considered by many to be unattractive and usually requires intervention. (Garber & Salama, 2000; Ricketts, 1968; Singer, 1974; Jnzen 1977; Mack, 1996; Silberberg et al., 2009; Rosenblatt & Simon, 2006; Ezquerra et al. 1999; Miron & Allon, 2012; Landsberg, 2006) Data from this study, similar to other studies, clearly indicate sexual dimorphism in lip and tooth measurements. These differences
are reflections of simple biologic scaling: male subjects are uniformly larger than equivalent female subjects.

The upper lip at rest was 1.8 mm shorter in the women than in the men (P<0.05), this comes in agreement with Peck et al,1992 who recorded vertical measurements in young orthodontic patients (mean age, 15 years), observed that the difference in upper lip length between the sexes was only 2.2 mm. No difference was observed in maxillary incisor exposures at rest between the genders this finding came in disagreement with Miron et al (2012), and this results may be due to sample age and sample type as in this study the sample was class I normal occlusion while another study was without classification or malocclusion. The clinical central incisor crown was 0.5 mm shorter in the women than in the men, slightly less than the difference observed by Peck et al. (1992). Upper lip vermilion height, defined elsewhere as upper lip thickness, comprised 42% of the whole upper lip length in women and 35% in men25. This observation was somewhat similar to other studies.(Desai et al., 2009; Perenack, 2005). The mean maxillary central incisor display at smiling was different in both genders and this comes in partially agreement with Peck et al.(1992) and don't agree with Miron et al (2012), and this may be due to sample age and its orthodontic classification. The upper lip length was 23% shorter in maximum smiling relative to the resting position in both genders this comes agreement with Peck et al. (1992) and Miron et al (2012). Our findings suggest that a low smile pattern can be considered a female norm(67%), since more than half of the women in this study don't exposed their gums while smiling, and a low smile pattern can be considered a male norm (53%). Similar results and female/male ratios were observed by others in slightly younger population groups. (Tjan et al., 1984; Polo, 2008; Peck et al., 1992).

Although other authors have found a 2:1 ratio of gingival exposure between female and male subjects, we found of 1 women to 1 man in exposure of gingivae when smiling. (Tjan et al., 1984; Polo, 2008; Peck et al., 1992) In our opinion, this might be attributed to the difference between the study groups because of mean age or ethnic-related features, also this study based on class I malocclusion as the subjects with different dental arch classes can effects on the position and relation of the lips in rest and during smile.(Proffit & Fields, 2000). Table III compares smile patterns by sex between this study and previous studies.

Table III Comparison of smile patterns with other studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Female</th>
<th></th>
<th>Male</th>
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<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Tjan et al.,1984</td>
<td>34 (14%)</td>
<td>31 (12%)</td>
<td>14 (7%)</td>
<td>62 (30%)</td>
</tr>
<tr>
<td>Rigsbee et al.,1988</td>
<td>32 (70%)</td>
<td>—</td>
<td>21 (38%)</td>
<td>—</td>
</tr>
<tr>
<td>Peck et al.,1992</td>
<td>25 (54%)</td>
<td>7 (15%)</td>
<td>11 (26%)</td>
<td>14 (33%)</td>
</tr>
<tr>
<td>Current study</td>
<td>2 (11%)</td>
<td>12 (67%)</td>
<td>2 (14%)</td>
<td>8 (53%)</td>
</tr>
</tbody>
</table>

Conclusions

Data from this study clearly indicate sexual dimorphisms in upper lip length, maxillary incisor display, and resting external upper lip length. Low smile patterns are more common among female patients, and also common among male patients while high smile are less common among female and male patients. The average smile is more prevalent in male than female.
References
Polo M. 2008 Botulinum toxin type A (Botox) for the neuromuscular correction of excessive gingival display on smiling (gummy smile). Am J Orthod Dentofacial Orthop;133:195-203.