INTRODUCTION
Attractiveness is difficult to interpret objectively but some objective assessment criteria are suggested to make a smile praiseworthy in everyone's eyes.¹-⁸ Objective standardization of an attractive smile implies a smile which possesses some properties that makes a smile distinctly praiseworthy in everyone's eyes. In this regard Sabri reviewed 8 major components of smile and discussed their impact on aesthetics and therefore on orthodontic treatment planning.⁸ Discrepancies in the subjective assessment of attractiveness can add to the perplexity. These uncertainties are the orthodontist's challenge while planning for a particular patient. Orthodontists are consequently obligated to identify beauty, harmony, balance and proportion as demanded by people.

Smile is a sum of many attributes.⁹ Smile attractiveness has been studied as a separate entity from face.¹⁻¹⁴ Face type can have an influence on the smile aesthetics and the opposite can also be true. In an effort to create good natural aesthetics, the orthodontist must give a careful consideration to the patient in entirety. Aesthetic tradeoffs in all smile dimensions should be considered; the most apparent of which in frontal dimension is the vertical smile character.⁸ Vertical smile characteristics are the relationships between the incisal edges of the maxillary incisors and the lower lip, and between the gingival margins of the maxillary incisors and the upper lip.² Because teeth do not exist individually separate from the face, a proportional balance between both should be the aim. Achieving a perfect attractive smile for the particular face type is more difficult than simply putting all the teeth perfectly over the jaw bones. Success of treatment holds different meanings to orthodontists but success for the patient is the final esthetic outcome.¹⁵

Focus on the lineaments of the smile is not a step back in time; rather, it represents a re-emphasis of the importance of physical diagnosis and the appreciation of the soft tissues that both drive our treatment planning and limit the treatment response. New technology simply enhances our ability to see our patients more dynamically and facilitates the quantification and communication of newer concepts of function and appearance.² Studying smile aesthetics in different face types is difficult because of the inability to standardize the frame of the smile. Smile characteristics which can make a smile more 'attractive' in a particular face type may not be as 'attractive' in another face type. The aim for an attractive smile for a particular face type should be tempered with the recognition of the associated risk on the overall facial attractiveness.

ABSTRACT
Objective: To determine the effect of altered lip line on attractiveness and to find preferred lip line for vertical face types in both genders.
Study Design: Cross-sectional analytical study.
Place and Duration of Study: The Aga Khan University Hospital, Karachi, from May to July 2009.
Methodology: Photographs of two selected subjects were altered to produce three face types for the same individual with the aim of keeping the frame of the smile constant. Lip line was then altered for both the subjects as: both dentitions visible, upper incisors visible, upper incisors and 2 mm gum and 4 mm gum visible. The pictures were rated by different professionals for attractiveness. Descriptive statistics for the raters and multiple factor ANOVA was used to find the most attractive lip line.
Results: The total number of raters was 100 with the mean age of 30.3 ± 8 years. The alterations in the smile parameters produced statistically significant difference in the attractiveness of faces, whereas the perception difference was found to be insignificant amongst raters of different professions. Preferred lip line was the one showing only the upper incisors in dolico and mesofacial male and female genders whereas 2 mm gum show was preferred in brachyfacial subjects.
Conclusion: The variability in lip line showed significant difference in the perceived attractiveness. Preferred lip lines as the one showing only the upper incisors in dolico and mesofacial male and female genders whereas 2 mm gum show was preferred in brachyfacial subjects.

Key words: Aesthetics. Face type. Lip line. Smile.
This study was therefore undertaken to determine the effect of alteration of lip line on attractiveness and to find an attractive lip line for a particular face type.

**METHODOLOGY**

This cross-sectional analytical study was done at the Aga Khan University Hospital, Karachi, from May to July 2009. After taking the written and verbal informed consent, various subjects were selected for posed frontal smiling photographs. Subjects were selected on the basis of facial symmetry and smile harmony. Any asymmetries in the face and smile were excluded from the sample. Finally one male and one female subject (aged 20 and 19 years respectively) were finally selected on the basis of optimal harmony and symmetry in their face and smile. A new set of different frontal posed smiling pictures were taken of the two selected subjects to capture the best frontal smiling photograph. The photographs were then altered using Adobe Photoshop Version 8.0 (Adobe Systems, San Joe, CA, USA) with some professional help in this regard. The pictures were first altered to make three face types for the same subject by altering the face height to width ratios as shown in Figure 1. Lip line was then altered. Lip line was modified as: both dentitions visible, upper incisors visible, upper incisors and 2 mm gum and 4 mm gum visible as shown in Figure 2 for the male and female gender. The modified images were imported into Microsoft Power Point (Microsoft, Redmond, WA, USA) as a presentation in a predetermined order for evaluation by 100 judges belonging to different professions including orthodontics, restorative dentistry, arts and fashion and lay persons. A five point visual analogue scale from 1 - 5, with an interval of a whole number on a data collection form was used to rate the images, projected for a set number of seconds in order to standardize the rating of every picture for each rater.

![Figure 1: Different face types for the female and male subject.](image)

![Figure 2: Lip line variations for male and female subject in the three face types.](image)
Data were analyzed using Statistical Package for Social Sciences (SPSS) for Windows Version (Chicago Inc.). Descriptive statistics were computed for the raters belonging to different professions. ANOVA was used to determine possible age differences and chi-square was used to evaluate gender distribution of raters. Mean score for every altered picture was computed for all the raters as group and for the raters belonging to different professions. Multiple factor ANOVA was used to evaluate any aesthetics perception difference amongst the raters of different groups and to determine the most preferred lip line for a particular face type. The level of significance for all statistical test was kept at less than or equal to 0.05.

RESULTS

The total number of raters was 100, amongst them 25 were orthodontists, 25 were restorative dentists, 25 were arts and fashion designers and 25 were lay persons. Table I shows the descriptive statistics for the raters. The mean age of the raters was 30.3 years ± 7.8 years. Results of ANOVA showed that there was no statistical difference in age amongst all the groups (p = 0.20). There was equal gender distribution in all groups (p = 0.956).

Table II shows the mean scores for the three face types for the altered lip line. In the dolicofacial and mesofacial subjects, the highest mean score was for a lip line showing only the upper incisors. Whereas for the brachyfacial subjects a 2 mm gum show was preferred for both genders.

Table III shows the results of multiple factor ANOVA. The lip line alteration denotes the variability in the lip line done to the pictures whereas the raters group denotes the raters belonging to different professions in order to note any possible difference in the perception of aesthetics. When the altered lip line and group of raters are taken together there is statistically insignificant difference in the perception of aesthetics for the altered lip line in all the three face types which shows statistically insignificant difference in perception of aesthetics amongst different professionals. However,

<table>
<thead>
<tr>
<th>Lip line preference for variant face types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table I: Descriptive statistics.</strong></td>
</tr>
<tr>
<td>Rater group</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Mean age</td>
</tr>
<tr>
<td>Orthodontists</td>
</tr>
<tr>
<td>Restorative dentist</td>
</tr>
<tr>
<td>Arts and fashion</td>
</tr>
<tr>
<td>Layperson</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontists</td>
<td>25</td>
<td>12 (48)</td>
<td>13 (52)</td>
<td>*p = 0.956</td>
</tr>
<tr>
<td>Restorative dentist</td>
<td>25</td>
<td>11 (44)</td>
<td>14 (56)</td>
<td></td>
</tr>
<tr>
<td>Arts and fashion</td>
<td>25</td>
<td>12 (48)</td>
<td>13 (52)</td>
<td></td>
</tr>
<tr>
<td>Layperson</td>
<td>25</td>
<td>13 (52)</td>
<td>12 (48)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>48 (48)</td>
<td>52 (52)</td>
<td></td>
</tr>
</tbody>
</table>

Test of significance: \*p : ANOVA; \*p : Chi-square; Level of significance: p < 0.05

**Table II: Mean scores for lip line preferences in the three face types.**

<table>
<thead>
<tr>
<th>Lip line</th>
<th>Category</th>
<th>Dolicofacial</th>
<th>Mesofacial</th>
<th>Brachyfacial</th>
<th>Dolicofacial</th>
<th>Mesofacial</th>
<th>Brachyfacial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
</tr>
<tr>
<td>Upper incisor only</td>
<td>Orthodontist</td>
<td>3.08 ± 1.2</td>
<td>3.83 ± 0.9</td>
<td>2.67 ± 0.7</td>
<td>2.42 ± 1.0</td>
<td>3.50 ± 0.7</td>
<td>2.20 ± 0.6</td>
</tr>
<tr>
<td></td>
<td>Restorative dentist</td>
<td>4.00 ± 0.9</td>
<td>3.23 ± 0.8</td>
<td>2.38 ± 1.2</td>
<td>2.62 ± 1.4</td>
<td>3.31 ± 0.8</td>
<td>2.40 ± 1.5</td>
</tr>
<tr>
<td></td>
<td>Arts and fashion</td>
<td>3.29 ± 1.3</td>
<td>3.29 ± 0.7</td>
<td>2.36 ± 1.1</td>
<td>2.43 ± 1.1</td>
<td>3.43 ± 1.2</td>
<td>2.57 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Layperson</td>
<td>3.27 ± 1.1</td>
<td>3.18 ± 0.8</td>
<td>2.09 ± 0.8</td>
<td>2.73 ± 0.5</td>
<td>3.91 ± 0.8</td>
<td>2.60 ± 0.8</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.42 ± 1.1</td>
<td>3.38 ± 0.8</td>
<td>2.38 ± 1.0</td>
<td>2.54 ± 1.0</td>
<td>3.52 ± 0.9</td>
<td>2.51 ± 1.1</td>
</tr>
<tr>
<td>Upper and lower incisors</td>
<td>Orthodontist</td>
<td>2.58 ± 1.3</td>
<td>3.42 ± 0.9</td>
<td>2.25 ± 0.9</td>
<td>1.92 ± 0.8</td>
<td>3.17 ± 0.9</td>
<td>2.20 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>Restorative dentist</td>
<td>3.15 ± 1.6</td>
<td>3.00 ± 0.7</td>
<td>2.15 ± 1.1</td>
<td>2.69 ± 1.3</td>
<td>3.08 ± 0.6</td>
<td>2.46 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>Arts and fashion</td>
<td>2.86 ± 1.2</td>
<td>3.29 ± 0.6</td>
<td>2.07 ± 1.0</td>
<td>2.21 ± 1.1</td>
<td>3.19 ± 0.9</td>
<td>2.30 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Layperson</td>
<td>2.55 ± 1.1</td>
<td>2.82 ± 1.3</td>
<td>2.73 ± 0.9</td>
<td>2.55 ± 0.9</td>
<td>3.55 ± 1.3</td>
<td>2.10 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2.80 ± 1.3</td>
<td>3.14 ± 0.9</td>
<td>2.28 ± 1.0</td>
<td>2.34 ± 1.0</td>
<td>3.26 ± 1.1</td>
<td>2.20 ± 1.1</td>
</tr>
<tr>
<td>2 mm gum</td>
<td>Orthodontist</td>
<td>2.75 ± 1.1</td>
<td>3.08 ± 1.2</td>
<td>2.50 ± 0.8</td>
<td>1.67 ± 0.7</td>
<td>2.33 ± 1.1</td>
<td>2.50 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Restorative dentist</td>
<td>3.15 ± 1.2</td>
<td>3.00 ± 1.3</td>
<td>2.38 ± 1.2</td>
<td>2.77 ± 1.2</td>
<td>2.92 ± 0.8</td>
<td>2.08 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>Arts and fashion</td>
<td>3.14 ± 1.1</td>
<td>2.93 ± 0.7</td>
<td>2.64 ± 1.1</td>
<td>2.21 ± 1.3</td>
<td>2.93 ± 0.9</td>
<td>2.50 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Layperson</td>
<td>3.36 ± 0.8</td>
<td>3.73 ± 1.2</td>
<td>2.82 ± 0.6</td>
<td>2.00 ± 0.9</td>
<td>3.09 ± 1.1</td>
<td>2.82 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.10 ± 1.1</td>
<td>3.16 ± 1.1</td>
<td>2.58 ± 1.0</td>
<td>2.18 ± 1.1</td>
<td>3.21 ± 1.0</td>
<td>2.60 ± 1.1</td>
</tr>
<tr>
<td>4 mm gum</td>
<td>Orthodontist</td>
<td>2.00 ± 0.8</td>
<td>2.92 ± 1.2</td>
<td>2.08 ± 0.8</td>
<td>1.83 ± 0.9</td>
<td>2.67 ± 0.9</td>
<td>2.50 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>Restorative dentist</td>
<td>2.46 ± 1.1</td>
<td>2.69 ± 1.2</td>
<td>2.15 ± 1.0</td>
<td>2.46 ± 1.2</td>
<td>3.23 ± 1.0</td>
<td>2.38 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>Arts and fashion</td>
<td>2.07 ± 1.1</td>
<td>2.86 ± 1.0</td>
<td>2.21 ± 1.1</td>
<td>2.00 ± 1.0</td>
<td>3.00 ± 1.2</td>
<td>2.36 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Layperson</td>
<td>2.82 ± 1.2</td>
<td>3.36 ± 0.8</td>
<td>2.73 ± 0.9</td>
<td>2.45 ± 0.8</td>
<td>3.82 ± 0.8</td>
<td>2.80 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2.32 ± 1.1</td>
<td>2.94 ± 1.1</td>
<td>2.28 ± 1.0</td>
<td>2.18 ± 1.0</td>
<td>3.16 ± 1.1</td>
<td>2.58 ± 1.1</td>
</tr>
</tbody>
</table>

Test of significance: \*p : ANOVA; **p : Chi-square; Level of significance: p < 0.05

**Table III: Result of repeated measure ANOVA.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Gender</th>
<th>Face type</th>
<th>Dolicofacial p-value</th>
<th>Mesofacial p-value</th>
<th>Brachyfacial p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lip line alteration</td>
<td>Male</td>
<td>Dolicofacial</td>
<td>0.001</td>
<td>0.01</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Mesofacial</td>
<td>0.04</td>
<td>0.0001</td>
<td>0.03</td>
</tr>
<tr>
<td>Lip line alteration</td>
<td>Male</td>
<td>Brachyfacial</td>
<td>0.35</td>
<td>0.23</td>
<td>0.22</td>
</tr>
<tr>
<td>and raters group</td>
<td>Female</td>
<td></td>
<td>0.62</td>
<td>0.42</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Test of significance: ANOVA; Level of significance: p < 0.05.
when only lip line alteration is considered, statistically significant difference is observed in the perceived attractiveness of the face.

DISCUSSION

In problem-oriented treatment planning approach the orthodontist must establish a diagnosis that identifies and quantifies which elements of the smile need correction, improvement, or enhancement. The contemporary orthodontist no longer evaluates patients in terms of only the profile, but also frontally and vertically, to complete the 3 spatial dimensions, and statically and dynamically. An attempt has been made in this study to standardize attractive lip line preference as dictated by the face type.

Defining an attractive smile is a difficult task. The contribution of various raters from different professions in search for the ultimate attractive smile for a particular face type was the rationale of the current study. The discrepancy of perception between different professionals can add to the perplexities in the definition of an attractive smile. The purpose of this investigation was to broaden the understanding of the impact of specific face types on the overall smile aesthetics and to establish contemporary concepts of smile aesthetic preferences according to the face type. The techniques of alteration of the same face into three face types freed the raters from the concern of other confounding and decisive features of the face. The ratings have enabled the formulation of some guidelines in designing an attractive smile for a particular vertical face type.

According to Schabel et al., no correlation was found between cases passing the ABO objective grading system which is the orthodontist's success criteria and the aesthetics of the smile. Harmony of teeth to both intra and extra oral soft tissues makes a smile more attractive and hence this should be one of the prime objective in planning treatment for the improvement of facial aesthetics.

This study results showed that variations in lip line have statistically significant difference on the perceived attractiveness in all the three face types. At the same time, the subjective assessment of attractiveness did not vary significantly amongst people of different professions. This means that the perception difference was not significantly different between raters belonging to different professions. This is in agreement with some studies like that of Ritters et al., who compared the aesthetic influence of orthodontists and lay persons on smile widths during smiling and found no difference in subjective aesthetic assessment. Krishnan et al. analyzed the perception difference between dental specialists and laypersons and found no perception difference between specialists and lay persons on the smile evaluation. Erum and Fida concluded that orthodontists, dentists, lay persons and art students share similar aesthetic perception. Also, McNamara et al. found a high agreement in judgments between laypersons and orthodontists. However, some previous studies have disagreed on this observation. Tedesco et al. found that laypersons were more sensitive to dento-facial impairments than those with orthodontic training. On the other hand Johnson and Smith and Kokich et al. found that dental professionals were more sensitive to minor dental disharmonies. Mean aesthetic score in this study showed that the highest scores were given by the restorative dentists, whereas the least scores were given by arts and fashion people. This pattern shows the aesthetic demands by the professional which are therefore highest for the arts and fashion people. The aesthetic perception therefore can vary from profession to profession or person to person. Kokich et al. showed that orthodontists found smiles most attractive when no gingiva was displayed and less attractive when 2 mm of gingiva was exposed; general dentists and laypersons were more tolerant in classifying gingival exposure as excessive once 4 mm of gingiva was displayed. Peck et al. concluded that smile line might not be as objectionable as orthodontist might think.

This study examined the attractiveness with regard to alterations of lip line to find the most acceptable lip line for the particular face type. Flores-Mir et al. concluded that gingival display is compatible with pleasing smiles in lay person eyes and therefore some gum show was recommended by him. Geron concluded a 1 mm gingival exposure as within the aesthetic range. According to Sabri, an optimal smile is characterized by an upper lip that reaches the gingival margins. Sarver proposed that a complete lack of gingival display (defined in terms of the percentage of incisor's show on smile) is not as attractive as some gingival display. This study results showed that preference for a lip line with upper incisor show only in dolicho-facial and mesofacial male and female subjects, whereas 2 mm gum show for brachy-facial male and female subjects. This is partly in contrast to the result of Erum and Fida where no gum show was preferred by all the professionals, but the subjects chosen for smile assessment in their study were only of mesofacial face as compared to the present study, where faces of different vertical types were analyzed. The preference of lip line for different face types cannot be compared with any study because this is the first study done on the subjects of smile preference for three face types with the same smile frame and therefore removes any bias created by the differing frame of the smile. A greater gum show preference in brachy-facial subjects according to the author is due to the face type compatibility where a more gum show might add a balancing effect to the facial profile. A 4 mm gum show was also preferred in
female brachyfacial subjects (mean score for 2 mm gum = 2.60 and for 4 mm gum = 2.58), which might be due to relatively more youthful smile preference for female subjects. So some gender based guidelines can be chosen as Peck et al. also found sexual dimorphism of preferred smile lines in the vertical dimension.21 Gum show in smile is preferred more for females as compared to males.

This study results showed that lower incisor show was unaesthetic and was not preferred in both genders. According to Dunn et al., laypersons find having a greater number of teeth displayed more attractive than fewer teeth.23 Yet, the increased display of mandibular teeth has been described as a characteristic of aging; as maxillary lip coverage increases the amount of mandibular incisor display increases as well. McNamara et al. however, found no correlation between visible mandibular teeth and smile aesthetics.15

Although the acceptable range of gingival exposure varies by study, McNamara et al. found no correlation between gingival display and smile aesthetics.15 The results of various studies including our study suggest some guidelines for lip line, but the individual patient preference cannot be overlooked. The age of the patient also plays an important part as it is a characteristic of aging to show less of the maxillary incisors at rest and on smile, so that, to a degree, more tooth display is considered a more youthful smile.14 Therefore, more gum show should be planned for the young patient to give a long lasting youthful appearance.

In evaluating aesthetics, people belonging to different professions can share similarities in some respect and differences in some other respect. A better consideration of these is important for an orthodontist planning treatment for their patients. Also important is the patient's own preference for attractiveness. Treatment should better be individualized so that individual patient's aesthetic preference is incorporated yet the various guidelines laid by the results of various studies mentioned in the discussion should be known to every orthodontist. Individual patient's age, gender and the profession might help in designing the best possible smile for the patient which can satisfy the patient and be considered praiseworthy in everyone's eyes.

CONCLUSION

The results of this study showed that alterations in lip line results in statistically significant difference in the perceived attractiveness of the face. In the dolicofacial and mesofacial male and female subjects, the preferred lip line showed only the upper incisors, whereas for the brachyfacial subjects a 2 mm gum show was preferred for both genders. Statistically insignificant difference in perception of aesthetics was found amongst raters from different professions.

REFERENCES


