



## UNVEILING THE SMILE TRAITS: THE FORENSIC IMPORTANCE

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**ABSTRACT** **Background-** This cross sectional study was conducted to correlate the various smile characteristics such as- smile line, smile arcs, lip curvature, gingival exposure and maxillary central incisor exposure with gender in north Indian population. **Materials and methods-** The study was conducted in department of Oral Pathology and Microbiology department at Shree Bankey Bihari Dental College & Research Centre, Uttar Pradesh, India. A total of 100 research participants were selected according to inclusion and exclusion criteria out of which 56 were males and 44 were females. To obtain the smile photographs, constant camera settings was used. The collected data were analyzed using Image-J software for sexual dimorphism and forensic identification. **Result-** Results of this study showed, out of 100 individuals 73 individuals have average smile line followed by low smile line & high smile line. Out of 100 individuals, 67 individuals have parallel smile arcs followed by flate smile arcs & reverse smile arcs. Out of 100 individuals 54 individuals have straight upper lip curvature followed by upward & downward upper lip curvature. Out of 100 individuals 48 have inter proximal gingival exposure followed by no gingival exposure & gingival exposure. Out of 100 individuals 57 individuals have >75% central incisor exposure followed by 43 individuals have <75% central incisor exposure. Out of 100 individuals 41 individuals showed square shaped incisors followed by rectangular shaped, round shape & triangular shape. **Conclusion-** Each individual's facial and dental features are unique, making them valuable in forensic dentistry for identification. These distinct traits also play a crucial role in enhancing personalized treatments in aesthetic dentistry.

**KEYWORDS :** Dental aesthetics, Smile design, Facial feature.

**INTRODUCTION:**

As the most intricate and refined facial expression, a smile is formed by the synergistic action of several facial muscles.<sup>1</sup> From a dental perspective, an aesthetically pleasing smile is characterized by a harmonious relationship between the anterior teeth, the gingival contour, and the lip framework.<sup>2</sup> The aesthetics of the face are greatly influenced by the presence of the maxillary anterior teeth.<sup>3</sup> The visibility of the anterior teeth when the lips are at rest or during function is a crucial aesthetic factor in determining the success of any prosthodontic treatment.<sup>4</sup> The lip-tooth relationship evolves over time, with a reduction in the visibility of maxillary incisors. Additionally, men and women exhibit distinct patterns in their lip-tooth relationships. Understanding age-related dentofacial changes is essential for clinical success, optimizing smile aesthetics, and ensuring healthy, long-lasting results for patients across all age groups.<sup>5,6</sup> A smile often serves as a facial expression indicating feelings of joy, friendliness, and thankfulness.<sup>7</sup> Analyzing a smile is important during the diagnosis including treatment planning stages in prosthodontics and aesthetic dentistry. Neurologically, smiles can be categorized into two types: involuntary (spontaneous) and voluntary (posed). An involuntary smile is driven by emotion, while a voluntary (social) smile is intentional and typically not associated with emotion.<sup>8</sup> A natural smile is defined by several key parameters, including the smile line, smile arc, smile type, upper lip curvature, teeth display, gingival exposure, buccal corridor, and the position of the incisal edge. Additionally, the dental-facial midline, symmetry, gingival display, and gingival zenith position are crucial for evaluating smile aesthetics. When designing a smile makeover, it is essential to consider all these factors. Moreover, since the norms for these smile characteristics can vary across different populations, ethnicity should also be considered as an important variable.<sup>9</sup> In modern dental practice, dento-facial aesthetics plays a crucial role, with patients increasingly seeking cosmetic and aesthetic procedures to enhance their appearance.<sup>7,10</sup> The purpose of this study was to study smile characteristics such as Smile line, Lip curvature, gingival exposure, maxillary central incisor exposure with Gender in North Indian population.

**MATERIALS AND METHODS:****STUDY DESIGN AND SAMPLING**

This study was conducted out at the Department of Oral Pathology & Microbiology, Shree Bankey Bihari Dental College & Research Centre, Ghaziabad, Uttar Pradesh, India, over six months period from November 2023 to May 2024. This study was approved by Institutional Ethical Committee of Shree Bankey Bihari Dental College & Research Centre. The sample for the present study was selected from out patient department of the institute. A total of 100 participants out of which 56 were males and 44 were females at age group of 18-30 years were selected for this study after considering inclusion and exclusion criteria. An informed written consent were taken from the participants.

**INCLUSION CRITERIA-**

1. No missing maxillary anterior teeth.
2. No gingival or periodontal conditions or therapies that would undermine a healthy tissue to tooth relationship.
3. Not undergone any previous dental restorative, esthetic or orthodontic treatment.
4. All anterior teeth were erupted.

**EXCLUSION CRITERIA-**

1. Crowding, artificial dentition
2. Periodontal disease with interproximal gingival recession greater than 2.0 mm.
3. Previous history of periodontal surgery.
4. Subjects undergoing orthodontic therapy during study.
5. Apparent loss of tooth structure due to attrition, fracture, caries or restorations

**DATA COLLECTION**

The smile photographs were taken using constant camera settings after obtaining informed written consent.

Following characteristics of smile were evaluated according to Mehwish Khan et al (2020)<sup>9</sup> and Riyad Al-Hababeh et al (2013)<sup>11</sup>

Smile line or lip line: The extent of vertical tooth display when smiling or elevating the upper lip in relation to the maxillary incisors is categorized into three types:

High Smile:	Displays the maxillary anterior teeth along with a significant amount of gingiva.
Average Smile:	Shows the maxillary anterior teeth with only interproximal gingiva visible.
Low Smile:	Reveals less than two-thirds of the maxillary anterior teeth.

Smile arc: The relationship between the curvature of the maxillary anterior teeth and the upper border of the lower lip is known as the smile arc. In a study, this relationship was assessed by drawing a line along the incisal edges of the maxillary central incisors and extending it to the cusp tips of the maxillary canines, and then comparing it to another line drawn along the superior border of the lower lip. If the maxillary teeth were covered by the lower lip, the smile arc was considered "not available." There are three categories of smile arcs:

Consonant Smile	The lines are parallel, meaning the curvature of the maxillary teeth follows the same curve as the upper border of the lower lip.
Straight Smile	The curvature of the maxillary teeth is flatter compared to the upper border of the lower lip
Reverse Smile	The curvature of the maxillary teeth is reversed compared to the upper border of the lower lip.

A nonconsonant smile can be classified as either "straight" or "reverse," depending on the relationship between the curves of the teeth and the lower lip.

Upper lip curvature: A straight line was drawn through the midpoint of the inferior border of the upper lip and its relationship with the corners of mouth evaluated. Three categories identified, upward, straight, and downward.

Upward	The corners of the mouth lie above the horizontal line
Straight	The corners of the mouth at or within 1 mm of the line
Downward	The corners of the mouth lie below the horizontal line

Gingival exposure: The portion of the gingiva displayed was determined by subtracting the length of the visible teeth and their associated gingiva from the total length of the displayed clinical crown.

[Gingival Exposure = (Length of the visible teeth + length of the visible gingival) - Length of the displayed clinical crown]

Maxillary central incisor exposure: The distance between the incisal edges of the maxillary central incisors and the highest vertical point on the gingival margin of the maxillary central incisors.

Standardized posed smile photographs were taken of 100 subjects seated in a natural head position using a Logitech Brio 4K Pro Webcam, which was fixed in place with a tripod. Each image was then assessed using Image-J software.

**STATIATICALANALYSIS:**

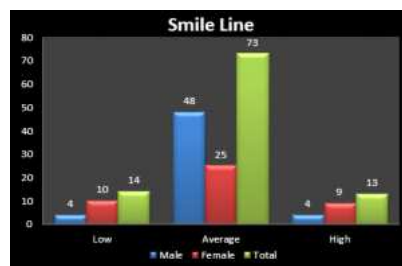
Data analysis was conducted using SPSS software (version 20). The Student's t-test and descriptive statistics were applied for initial analysis. To identify gender-based differences, the Pearson Chi-square test and Kruskal-Wallis test were utilized. Spearman's correlation coefficient was used to evaluate the correlation among smile parameters between the two genders. A 95% confidence interval was applied, with statistical significance set at  $p \leq 0.05$ . Pearson Correlation Coefficient,  $p \leq 0.05$  considered statistically significant with 95% confidence intervals.

**RESULT:**

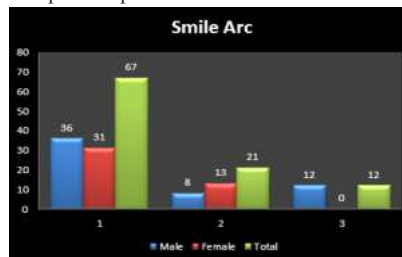
Result of this study shows, out of 100 individuals, 14 individuals (4 males & 10 females) have low smile line, 73 individuals (48 males & 25 females) have average smile line and 13 individuals (4 males & 9 females) have high smile line.[Graph 1] Out of 100 individuals, 67 individuals (36 males & 31 females) have parallel smile arcs, 21 individuals (8 males & 13 females) have flat smile arcs, 12 individuals

(12 males & 0 females) have reverse smile arcs.[Graph 2] Out of 100 individuals 46 individuals (24 males & 22 females) have upward upper lip curvature, 54 individuals (32 males & 22 females) have straight upper lip curvature, no individuals have downward curvature.[Graph 3] Out of 100 individuals, 39 individuals (20 males & 19 females) have no gingival exposure, 48 individual (32 males & 16 females) have inter proximal gingival exposure, 13 individuals (4 males & 9 females) have gingival display.[Graph 4] Out of 100 individuals 57 individuals (32 males & 25 females) have >75% central incisor exposure, 43 individuals (24 males & 19 females) have <75% central incisor exposure.[Graph 5] Out of 100 individuals 15 individuals (0 males & 15 females) showed round shape incisors, 41 individuals (24 males & 17 females) showed square shaped incisors, 36 individuals (24 males & 12 females) showed rectangular shaped incisors, 8 individuals (8 males & 0 females) showed triangular shaped incisors.[Graph 6]

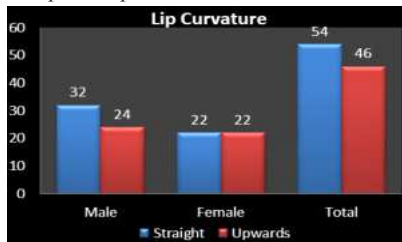
**FIGURES AND GRAPH**



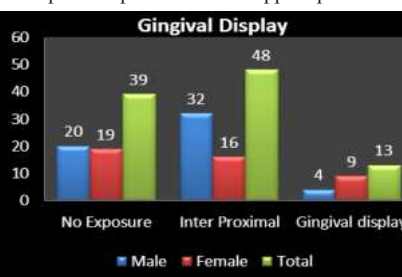
Graph 1: Graphical representation of smile line in males & females.



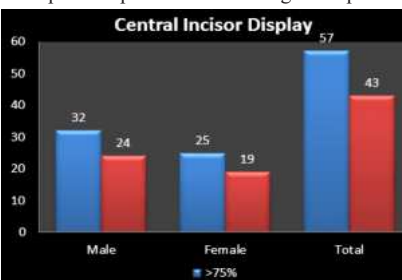
Graph 2: Graphical representation of smile arc in males & females.



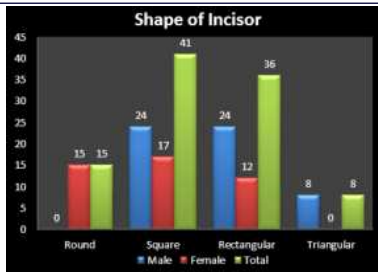
Graph 3: Graphical representation of Upper lip curvature.



Graph 4: Graphical representation of Gingival exposure



Graph 5: Graphical representation of Central incisor exposure



## DISCUSSION:

A detailed analysis of smile characteristics is a vital component in treatment planning for restorative dentistry, especially when addressing the anterior teeth in patients with high aesthetic expectations. This study focused on evaluating common features of a posed smile within a sample population from Ghaziabad. A posed smile was chosen for its consistent reproducibility. Key findings included the average smile line, smile arc, smile type, upper lip curvature, gingival display, maxillary central incisor visibility, and the shape of the incisors.<sup>9</sup>

The smile line plays a crucial role in clinical treatment, especially when managing patients with high smile lines. Care must be taken to prevent excessive gingival display when restoring anterior teeth in these individuals. In this study, the average smile line was the most frequently observed among participants. These findings are consistent with studies conducted by Tjan et al.<sup>7</sup> and Nold et al.<sup>12</sup> Tjan and Miller<sup>7</sup> also noted that a high smile line was the least common, which supports the results of the present study.

In contrast, Nold et al.<sup>12</sup> found that a low smile line was the least common among their study participants. Similarly, Nguyen et al. 2024<sup>13</sup> reported that a high smile line was the most common in their study population, which does not align with the findings of our study. Clinically, it is well-established that low smile lines are more forgiving of imperfections in anterior restorations, making it easier for dentists to achieve patient satisfaction with restorative dental procedures.<sup>14</sup>

In this study, the smile arc is defined according to the description provided by Sarver.<sup>14</sup> A consonant smile arc is typically viewed as more attractive than a non-consonant smile.<sup>15</sup> The most frequently observed smile arc among participants was the consonant smile arc, while the reverse smile arc was the least common. These findings are consistent with previous studies conducted by Tjan and Miller<sup>7</sup>, Nold et al.<sup>12</sup>, Nguyen et al. 2024<sup>13</sup>, and Desai et al.<sup>17</sup> However, Maulik and Nanda reported different results, noting that a straight smile arc was the most prevalent, found in 49% of their participants, followed by a consonant smile arc in 40%, and a reverse smile arc in 10%.<sup>18</sup> Their study differed in methodology from ours, as they captured spontaneous smiles via video recordings of both orthodontically treated and untreated subjects, whereas our study focused on posed smiles in otherwise healthy individuals. This methodological variation might account for the differences in findings.

According to Hulsey,<sup>19</sup> the most prevalent feature among subjects in his study was an upward lip curvature, which was not similar with the findings of the present study. This present study showed straight upper lip curvature was the most common in participants followed by upward upper lip curvature. Study conducted by Liang et al.<sup>20</sup> Shows similar findings but downward lip curvature was the second most common finding in their study. Dong et al.<sup>20</sup> found that straight to upward lip curvatures are generally considered more appealing than downward ones. They also noted that orthodontic treatment cannot alter the curvature of the upper lip, which means that achieving an ideal smile in patients with downward lip curvature can be challenging.<sup>21</sup>

This present study showed high number of participants have inter proximal gingival exposure, which was not accordance with the study conducted by Hababbeh et al 2013.<sup>22</sup> According to Hababbeh et al 2013<sup>22</sup> 45% of study population shows maxillary gingival exposure. About 39% study population shows no gingival exposure which was in accordance with the study conducted by Hababbeh et al 2013.<sup>22</sup> Half of the study population shows inter proximal gingival exposure in this present study.

Present study indicate gingival display more than 75% was high in males as compare to female, which was not in accordance in the study conducted by Drummond et al 2016.<sup>23</sup>

Most of the male participants have square and rectangular shaped incisors which is in accordance with the study conducted by Kurt et al 2005.<sup>24</sup> High number of female have square shaped incisors followed by round shape incisor, which is not in accordance with study conducted by Kurt et al 2005.<sup>24</sup>

## CONCLUSION-

Facial and oral features vary significantly between individuals, and there are notable differences between males and females in these characteristics. These features are crucial for aesthetic considerations, forensic analysis and the proper functioning of teeth. To obtain more accurate results and better understand these variations, further research with larger sample sizes is needed.

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