

Vertical dimension change analysis during smile with different parameters.

Drashti Chikhaliya, Thilagarani P.R., Jigar Doshi, Mamatha J., Jishna Vaghela, Urvashi Chauhan

Department of Orthodontic and Dentofacial Orthopaedics, College of Dental Science and Hospital, Amargadh, Bhavnagar, Gujarat, India.

Abstract

Background: In the recent years, esthetics has become the primary consideration for the patients seeking orthodontic treatment. Esthetics in orthodontics is mainly defined in terms of profile improvement. Esthetic judgment is made by observing the patient from the front in the dynamic states like conversation, facial expressions and smiling. Analysis of the vertical changes of smile is an important stage for the diagnosis, treatment planning and prognosis of any dental treatment involving aesthetic.

Aim and Objectives: The objectives of this study was to evaluate and quantify upper lip soft-tissue changes at both rest and maximum smile, to assess the differences of dimensions between the sexes, to assess differences between subjects with and without gingival display during the smile, quantification of differences in maxillary tooth exposure & assessment of crown height & width between the sexes and assessment of differences between different smile pattern groups.

Materials and Methods: 50 volunteers (25 men, 25 women) aged 20 to 40 were recruited for this study. For each subject, measurements of upper lip position and maxillary and mandibular incisor crown height at rest and in maximum smile, smile arc, smile symmetry were recorded. The individual measurements were correlated with sex distribution.

Results: Relaxed and smiling external upper lip length was shorter in the women than in the men. Resting vermilion height and the maxillary central incisor height was also lesser in females than in males. The mean maxillary central incisor display at rest was greater in the women than in the men. A high smile line was 1.5 times more prevalent in the women.

Conclusion: Data from this study clearly indicate sexual dimorphisms in upper lip length, maxillary incisor display, and upper labial vestibule insertion. Higher smile patterns are more common among female patients, and lower smile patterns are more common among male patients. These findings were observed in subjects with a high smile pattern compared with those with a low smile pattern.

Key words: Vertical dimensional changes, Sexual dimorphism.

Introduction

Smile is one of the most predominant expression contributing to facial attractiveness. In the recent years, esthetics has become the primary consideration for the patients seeking orthodontic treatment¹. “Esthetics” is a Greek word which deals with beauty. The term “Esthetics” in orthodontics has been defined mainly in terms of enhancement of the profile. It may be divided into two dimensions: objective (admirable) and subjective (enjoyable) beauty. Objective beauty suggested that the object possesses properties that make it unmistakably admirable. Subjective beauty is value laden and is related to the tastes of the person contemplating it². Dentofacial attractiveness is particularly important to a person’s psychosocial well being. People with a normal dental appearance are judged more socially attractive over many personal characteristics than those with malocclusions. Those with poor dental esthetics have been linked to lack of self-confidence and are thought to be disadvantaged in social, educational, and occupational settings.^{3,4,5}

Esthetics in orthodontics has been defined mainly in terms of profile enhancement, but if you ask lay people what an orthodontist does, their answers will usually include something about creating beautiful smiles.⁶ Analyzing the smile and obtaining averages for various smile components give an idea about a standard of

normalcy to serve as a guideline for the creation of an esthetic smile. Therefore, smile measure and establishment of different smile components help in establishment of beautiful smile.¹ Orthodontics as a branch involves in recognizing what is interfering with the smile. In orthodontics to establish a treatment plan it is important to diagnose what is abnormal. Certain parameters in functional problems lead us to a diagnosis of the anomalies. Similarly aesthetic problems also require certain parameters in order to quantify the defects and decide on the treatment planning².

The aim of this study was to

- 1) Evaluate and quantify soft tissue changes of the lip in the vertical dimensions at both rest and maximum smile.
- 2) Assessment of the differences of dimensions between the sexes as well as assessment of differences between subjects.
- 3) Quantification of differences in maxillary tooth exposure between the sexes and different smile pattern groups.

Material and methods

Fifty volunteers (25 men, 25 women) aged 20 to 40 years from Bhavnagar population were recruited for this study. No participants had undergone any previous orthodontic treatment that could affect the vertical position of the central and lateral incisors by either intrusive or extrusive mechanics, maxillofacial surgery or anterior maxillary tooth prosthodontic rehabilitation. For each subject, 6 measurements of upper lip position and maxillary incisor crown height at rest and in maximum smiling were recorded. The age and the sex of the volunteers were recorded. For recording the maximum smile position, each individual was requested to express his or her full smile a few times, and measurements were taken when the individuals successfully repeated the full smile pattern.

The following measurements were done on the volunteers:-

1. Resting external upper lip length (mm)- the vertical measurement from subnasale to the inferior border of the upper lip.(stomion superioris)
2. Smiling external upper lip length (mm) - the vertical measurement from to the lower border of the upper lip while smiling.
3. Resting maxillary central incisor height (mm) - the vertical measurement from the

lower border of the upper lip to the incisal edge of the left central incisor.

4. Smiling maxillary central incisor display (mm) - the vertical measurement from the incisal edge to the highest point of display of the incisor of right maxillary central incisor.
5. Smile arc: Relationship of the contour of the incisal edges of the maxillary anterior teeth relative to the curvature of lower lip during a social smile.
6. Smile symmetry: An asymmetry in the smile can be due to asymmetric smile curtain or transverse cant of the maxillary occlusal plane.

All measurements were recorded to the nearest millimetre directly on the face using a Digital vernier calliper (Resolution:0.1mm/ 0.01", Accuracy:±0.2 mm/0.01").

Results

Means and standard deviations, derived for all measured variables of the subjects, are reported with some statistical information.

The mean age of the whole study population was 25years.

Data was analyzed using SPSS version 23. Descriptives, independent t test, frequencies and chi square test for inter

gender comparison of various smile parameters.

A statistically significant sexual dimorphism was apparent in many of the measured variables.

1) Relaxed external upper lip length was 0.07 mm shorter in the men than in the women ($P > 0.05$).

2) Smiling external upper lip length was similar in both men & women.

3) Maximum incisor display at rest was 0.72mm higher in women than men ($P > 0.05$)

4) Maximum incisor display at smile was 1.62 mm greater in women than men ($P < 0.05$)

5) Females have more flat smile & males have more consonant smile. ($p > 0.05$) (Table 2)

6) Females have more symmetrical smile (88%) compare to males (76%) (Table 3)

7) Comparing maximum incisor visibility among gender, there is statistically significant difference in type of smile among gender with mostly low smile in male and average smile in female ($p < 0.05$) (Table 4).

There is no statistically significant difference between various parameters except at maximum incisor height at smile showed significant difference among gender with

higher visibility of incisors in female than male ($p = 0.026$)

A high smile line is in which 100% of clinical crown height and a band of contiguous gingiva is visible. A low smile line is in which $< 75\%$ of clinical crown height of maxillary central incisor is visible. An average smile line is in which 75-100% of clinical crown height of maxillary central incisor is visible. (Table 4)

Discussion:

Vertical anterior tooth display is a very important aspect of dental and facial esthetics. Observation of the patient from the front in dynamic states like conversation, facial expressions, and smiling is done to make an esthetic judgement of the patient.²

Low smile lines have been found by Peck et al.⁷ and Tjan and Miller⁸ to be predominantly a male feature (2.5 to one male to female) and a high smile line is predominantly female (two to one female to male). Studies conducted by Vig and Brundo⁹ have found sexual dimorphism in the smile patterns. These studies suggested that maxillary anterior tooth display to be almost double that of women as compared to men. Also females were found to be twice as likely as males to have a gummy smile.

Because of the sexual dimorphism in the smile line, we expected that the perception of esthetics will be dependent on the development of a “form concept.”⁷ Smile line is important for establishment of the dento-gingival relationship to produce an esthetic and functional harmony. There are several factors that will affect the smile line, for example the strength of lips muscles and its mobility, lip length, crown height, and skeletal jaw relationship specifically jaw length¹⁰. On the other hand, malalignment of teeth, abnormal passive eruption, and gingival recession including presence of “black triangle” in the interproximal area can lead to unaesthetic appearance.¹⁰

Gender plays a prominent role in determining smile line. Our findings show that average and high smile pattern can be considered as female (48% and 20% respectively) and male norm considered as low smile (68%). In the perspective of Puppin, report shows women likely to have average and high smile line (55.9% and 37.7% respectively) and men likely to have average and low smile line (54% and 23.8% respectively).¹¹ Another report by Peck et al observed average (52.2%) and high (32.5%) smile line in women but male usually feature average and low smile line (48% and 33% respectively)¹² Both of the report is close to our results in female findings. In our opinions, this might be allocated to ethnic-related

features and mean age difference but it requires further examination. Contrarily, Liebart et al. states that age and gender does not influence the position of smile line due to lip stretching during forceful smile¹².

A study conducted by Sepolia et al. in year 2014 that most Indians shows average smile line (59%) during forced smile regardless of gender. However, low smile line is dominant (49.5%) during natural smile.¹⁰ Sepolia et al also explained that the present of this result might be due to Indian culture where people are shy to smile normally unless being requested. In our study, Indian ethnic occupy highest percentage (34.6%) in low smile line category. However it is more likely that it is due to ethnic-related features, cultural assimilation and mean age difference.¹⁰ Hu et al from Peking University of Beijing, China carried a study to examine the smile line of Han-Chinese population¹³. In their study, most subjects show high followed by average and then low smile line (31%, 50% and 19% respectively). Hu et al also mentioned that Chinese population have higher smile line in comparison with Caucasian population due to Musculo-skeletal anatomical difference especially in the maxillary region.¹³ They mentioned that convex profile is more common in Chinese population as compared to Caucasian leading to more occurrences of high smile line in Chinese population.¹⁴

Our findings suggest that a high smile pattern can be considered a female norm, since more than half of the women in this study exposed their gums while smiling, and a low smile pattern can be observed a male norm. Similar results and female/male ratios were observed by others in slightly younger population groups^{15,16,17} compares smile patterns by sex between this study and previous studies. Although other authors have found a 2:1 ratio of gingival exposure between female and male subjects, we found a slightly higher ratio of 2.5 women to 1 man in exposure of gingiva when smiling.^{15,16,17} In our opinion, this might be attributed to the difference between the study groups because of mean age or ethnic-related features, but it requires further investigation.

Short upper lip and hyperactivity of the lip elevator muscles are 2 distinctive features observed in subjects with high smile patterns in this study. Contrary to the observation by Peck et al⁷ of no significant difference between the mean upper lip lengths of a gingival smile pattern and a reference group, we found that subjects with a high smile line have an upper lip on average 2.42 mm shorter than do subjects with a low smile pattern. The reduction in upper lip length was gradual among the smile pattern groups (high, average and low) in other words, the higher the smile pattern, the shorter the upper lip length. In keeping with

the reduction of upper lip length, maxillary incisor display at rest was higher among subjects with higher smile patterns.

Vertical maxillary excess, a bony hyperplasia of the maxilla in the vertical axis causing high maxillary central incisor display at rest and exposure of gingiva in smiling was not suspected among the subjects with a high smile line in this study because of the matching differences between upper lip length and maxillary central incisor display at rest among the low and high smile line groups. The 2.42 mm of upper lip length deficiency that was noticed in the high smile line group compared with the low smile line group was compensated with 2.55 mm of maxillary central incisor display in the high smile line group, therefore not supporting the diagnosis of vertical maxillary excess in subjects with a high smile line.

The morphological variation of maxilla, its rotation around the transverse axis and its position in sagittal plane, all have been implicated in the cases of an excessive or reduced MIDR (Maxillary incisor display at rest). Anterior maxillary dentoalveolar height, also regarded as anterior maxillary height or vertical maxillary height in literature,¹⁸ have been shown to be significantly associated with the excessive incisor display.^{7,19} The morphology of anterior maxilla is determined by both genetic and environmental factors. Studies have shown that the upper anterior

dentoalveolar height is affected by dental intrusion or extrusion, under the influence of different environmental or therapeutic factor.

Conclusion: Data from this study clearly indicate sexual dimorphisms in upper lip length, maxillary incisor display, and upper labial vestibule insertion. Higher smile patterns were more common among females, and lower smile patterns were more common

among males. The following findings were observed in subjects with a high smile pattern compared with those with a low smile pattern. Maxillary incisal display at rest was generally greater in females than males. Upper lip length was found to be the strongest predictor of the maxillary incisal display at rest; however, several soft tissue, hard tissue and dental components affected Maxillary incisal display at rest.

Table 1. parameters of vertical dimensions.

Parameter	N	Male		Female		P value
		Mean	SD	Mean	SD	
Age	25	21.28	1.646	22.00	1.581	0.121 NS
Resting external upper lip length	25	17.36	3.6693	17.43	2.5341	0.943 NS
Smiling external upper lip length	25	12.75	2.8743	12.75	2.0841	1 NS
Maximum Incisor height (At Rest)	25	0.48	1.2245	1.20	1.9285	0.126 NS
Maximum Incisor height (smile)	25	6.28	3.22	7.90	1.46	0.026

Table 2: Comparison of smile arc

Smile Arc	Male		Female	
	Frequency	Percent	Frequency	Percent
Consonant	21	84.0	19	76.0
Flat	4	16.0	6	24.0
Total	25	100.0	25	100.0
Chi –sq		0.500	P value	0.480 NS

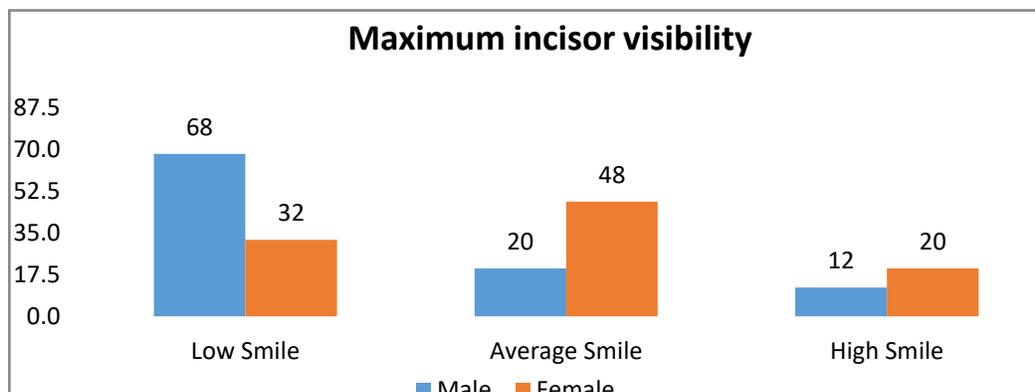
Table 3: comparison of smile symmetry

	Male		Female	
Smile symmetry	Frequency	Percent	Frequency	Percent
Asymmetrical	6	24.0	3	12.0
Symmetrical	19	76.0	22	88.0
Total	25	100.0	25	100.0
Chi –sq		1.220	P value	0.269 NS

Table 4: Comparison of smile type.

Smile Type	Male		Female	
	Frequency	Percent	Frequency	Percent
Low Smile	17	68.0	8	32.0
Average Smile	5	20.0	12	48.0
High Smile	3	12.0	5	20.0
Total	25	100.0	25	100.0
Chi – Sq	6.6		P value	0.036*

Graph 1: Smile pattern in male and female



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Corresponding Author:

Dr. Drashti Chikhalia
Department of Orthodontics and
Dentofacial Orthopaedics, College of
Dental Science and Hospital, Amargadh,
Bhavnagar, Gujarat, India.
Email ID: dkchikhalia23@gmail.com