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Upper Lip Changes on Smiling in the Vertical Dimensions

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Abstract:

Background: An attractive smile is considered as a valuable asset. As esthetically acceptable smile can never be created by beautiful teeth only, to establish harmony among teeth, lips and gingival display, pre-treatment evaluation of upper lip changes on smiling in the vertical dimensions helps the Orthodontists to determine the parameters that constitute an esthetically acceptable smile or pretty smile. Appropriate knowledge of soft tissue function and aesthetic help orthodontists to obtain stable and aesthetically appealing treatment results.

Methods: The study was conducted on Ninety-six (96) participants (48 men, 48 women; aged 20 to 35). For each subject, nine (9) measurements of upper lip position and maxillary incisor crown height at rest and in maximum smile were recorded from their photographs. The photographic records were analyzed with the software for Windows, Digimizer medicalc 4.2.2. The individual measurements were correlated with sex distribution.

Results: Relaxed and smiling external upper lip length and resting internal 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.

Conclusion: Data from this study clearly indicated sexual dimorphisms in upper lip length, maxillary central incisor display and labial vestibular insertion.

Key words: Central incisor length, Maximum social smile, Upper lip changes.

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Introduction

The lips, an essential smile element, contribute remarkably to facial esthetics. The upper lip is elucidated anatomically by the vermillion (pink lip), The ergotrid (white lip) and the labial mucosa.[1] The position of upper lip in relation to the teeth and gingiva during smiling determine the smile type (high, average, low).[1] During a natural smile, usually only a small portion of the gingiva is viewed.[2] When a person smiles, if excessive amount of gingival tissue is shown, it is called "Gummy smile".[2]

Esthetic is a Greek word which means perception of beauty.[3] It can be defined as the branch of Philosophy which deals with 'beauty' and 'the beautiful'. Esthetics have become increasingly important in modern dentistry.[4,5] It is said that, eyes are mirror to the heart; then a smile can be considered as an important determinant of the facial attractiveness of an individual.[6] During interpersonal interaction, individuals mainly focus on person's eyes and mouth.[7] So, facial attractiveness and smile esthetics are strongly related to each other. The esthetic appearance of the oral region during smiling is a conspicuous part of facial attractiveness because the mouth is the center of communication in the face.[4,8] Kiekens[9] believed that smile esthetics contributes to 25%–31% to facial attractiveness.[8]

A well balanced, attractive smile is a highly regarded treatment objective, along with creating a functional occlusion.[11] An attractive smile is considered as a valuable asset.[12,13,14] A person's age, sex, emotion and personality has influence on his/her smile.[15] As per Graber and Salama,[16] the essentials of the aesthetic smile comprises of the relationship among three components; that are: teeth, lip framework and gingival scaffold.[17] Smile is a voluntary facial expression which indicates pleasure, happiness, joy and greeting.[17] Smile can be defined as a facial expression which is characterized by upward curving of the corners of the mouth. It is often used to indicate amusement, pleasure and derision.[4,18] Smile can be of two types: The posed or social smile and the enjoyment or Duchenne smile.[19,20,21] As posed smile is

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reproducible and can be generated on command, it is used routinely when facial esthetics and smile characteristics are evaluated.[4,19,22] The enjoyment or unposed smile is involuntary, natural in that it expresses authentic human emotion.[23] Smile harmony is not only determined by the shape , size, color, contour and position of the teeth; but also by the surrounding gingival tissue, it's health, position, margin, visibility and also by the dento-labial-gingival relationship.[24] The display zone of smile is framed by the upper and lower lips.

In Orthodontics, when a proper diagnosis and treatment plan is developed for a patient, the hard and soft tissues are analyzed in three dimensions: sagittal, vertical and transverse.[25] The vertical aspects of smile anatomy include the degree of maxillary anterior tooth display, upper lip coverage and gingival display.[26] The amount of teeth and gingival display and lip position and dynamics during smiling and speech are important diagnostic criteria in aesthetic dentistry, Orthodontics and dento-facial surgery. Adequate assessment of lip position is required for orthodontic diagnosis, especially in patients with asymmetry of the upper lip during smiling, reduced tooth display, unaesthetic gingival contours, exposed posterior gingiva, occlusal cants and gummy smile.[8] The ultimate positions of the anterior teeth and maxillary gingival display have definite effects on smile esthetics. Over the last decades, smile design and smile analysis have become key elements of orthodontic diagnosis and treatment planning.[27,28] Smile design and smile analysis usually involve a compromise between two contradictory factors: one is the esthetic desire of the patient and another is the patient's anatomic and physiologic limitations. Dentofacial and smile esthetics have become significant factors in a patient's motivation for orthodontic therapy.[29,30] Examination and improvement of the factors that constitute an esthetic smile are very important for orthodontists because smile attractiveness is the parameter which most patients use to appraise the success of orthodontic treatment.[30,32]Cephalometric radiograph, which is a very important and helpful diagnostic tool; does not record lip-tooth relationship during smiling and speech. So, photographs and clinical observations of the face at rest and smiling position are very much important to obtain this valuable information. Using digital photograph and computer software technology the clinician can evaluate the patient's dynamic anterior tooth display and incorporate smile analysis into routine treatment planning. An esthetically pleasant and attractive smile is a harmonious entity of oral components in which the lip-tooth relationships are crucial factors.[33] To evaluate this lip-tooth relationship, a smiling record of the patient is necessary which is being traditionally taken by photographs as orthodontic records.[34] Among the traditional photographic techniques, only a posed smile is considered sufficient to obtain a reproducible diagnostic record.

Facial expression and physical attractiveness form essential parts of social interaction. The importance of attractiveness and beauty is well established in today's society. A person's psychological well beings hugely depends on his/her dento-facial attractiveness.[3] According to Langois,[35] facial and dental attractiveness is highly correlated with a better lifestyle and interpersonal success.[10] Amongst various personal characteristics, normal dental appearance is considered to be more socially acceptable than those with malocclusion.[36] Ideal occlusion will certainly remain the primary functional goal of orthodontics, but the aesthetic outcome is critical for patient satisfaction and therefore it is essential to the overall treatment objectives.[37] Since, most of the patients take decision to undertake orthodontic treatment primarily on the basis of esthetic considerations, the evaluation and calculation of the factors that influence their facial and smile esthetics are essential.

Several studies were conducted worldwide related to smile esthetics where different authors investigated the vertical aspects of smile anatomy. They have proposed various acceptable parameters for esthetic smile. In Bangladesh, few studies[38] have been conducted and found to be related to smile esthetics that include smile type, smile arc, ratio of smile index and buccal corridor etc. But photographic evaluation of upper lip changes and gingival exposure at rest and smiling in the vertical dimensions has not been done in Bangladesh yet.

Aim of the present study was to set male and female norms of upper lip changes on smiling in the vertical dimensions in Bangladesh. This study will be a great help to the orthodontists at treatment planning stage. It will have significant impact on determining the final aesthetic outcome. Therefore, proper clinical assessment and careful case planning will ensure accurate decision making before treatment.

Materials and Methods:

For each subject, nine (9) measurements of upper lip position and maxillary incisor crown height at rest and in maximum social smiling were recorded from patient's photographs.

The photographic set-up consisted of a tripod supporting a digital camera (Canon EOS 700D). This was used to record anterior tooth display while the subjects will be giving a maximum social smile. 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. Adjustment of the tripod height allowed the optical axis of the lens to be maintained in a horizontal position during the recording; this was adapted to each subject's body height. The same illumination was used for photography of each individual.To standardize the technique, a fixed patient-camera distance, a cephalometric head holder and a natural head position were used. Two metallic scales were placed at right angle to each other. They were fixed to the cephalometric head holder.

The frame that best represented the patient's natural unstrained maximum social smile, that is, the most reproducible smile in all frames was selected and cropped to eliminate most of the nose, cheeks and chin to minimize the influence of background facial attractiveness.

In a sitting position, each subject was asked to be relaxed. The subjects had to look forward in the imaginary mirror, with their lips relaxed. Then Photograph was taken at rest position. The photographic records were analyzed with the software for Windows, Digimizer medicalc 4.2.2.

In addition, the age and sex of each subject were recorded. The measurements and the methods used to obtain these variables are as follows.

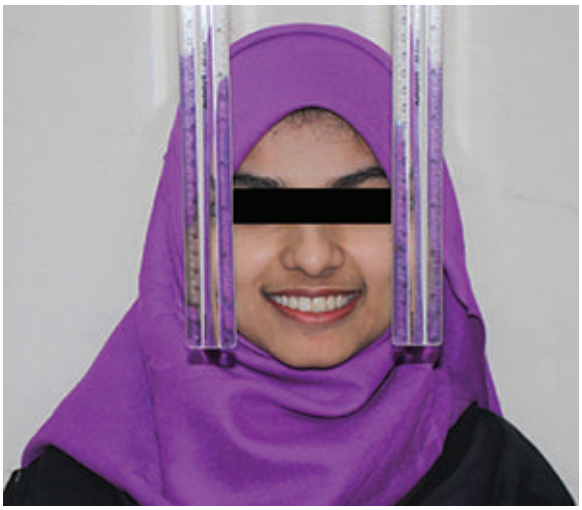

Figure 1: *Measuring scale hanging through the stand on both sides of the subject*

1. Performed both at rest and maximum smiling(fig :1):

Figure 2: *Vertical measurements at rest*

(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; and

(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.[9]

1. Performed once in maximum smiling when applicable:

Gingival display in maximum smiling, recorded in patients whose gingival display was noticed in the maximum smile.

Initially two points were created; one is the subnasale, corresponding to the upper border of the philtrum of the upper lip in the mid sagittal plane, another is the upper lip point, which corresponds to the lower border of the philtrum of the lip. The second point is situated just above the lip-vermillion border. A vertical line was then drawn corresponding to the mid sagittal plane using those two points as references.[34]

Two horizontal lines were then drawn one was the tangent to the superior most gingival margin of the central incisors and another was the tangent to the inferior most contour of the upper lip. Both the tangents were perpendicular to the vertical line. Finally the distance between the two tangents were measured in millimeters.[34]

Figure 3: *Vertical measurements at Maximum social smile*

Figure 4: *Measuring the Gingival display at maximum social smile position*

3. Performed once at rest position:

(a) Vertical measurement of Internal lip length was taken with an appropriate ruler (Esthetic Lip Ruler) that was slightly modified, from the labial vestibule apical to the central incisors to the inferior border of the upper lip (Fig 2).

Figure 5: *Esthetic Internal Lip Ruler*

Figure 6: *Measuring the internal lip length with internal lip ruler*

During ruler placement, the upper lip was slightly elevated temporarily, and the ruler was gently pressed into the center of the upper vestibule under direct vision until the anterior nasal spine was felt. Next, the upper lip was released and gently moved to verify that it was not under exaggerated tension. 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 eg, 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.

Before every recording, the operator ensured that the participant's forehead, neck, and ear were clearly visible. All procedures were undertaken by the same Operator. The photographic records were analyzed with the software for Windows, Digimizer 4.2.2. Internal upper lip length was measured by using the modified Esthetic Lip Ruler.

Data analysis

The measured parameters were entered in a excel sheet and then the data were transferred to Statistical Package for Social Science Software (SPSS) version 20 (IBM Corp, USA). The data analyzed through SPSS. Mean and frequency distributions were calculated for continuous and categorical variables. Chi-square test was used to justify the age variation in both sexes. Unpaired student t-test was done to assess the sex differences of study

parameters at both rest and smiling position. Chi-square test was done to evaluate the smile pattern by sex. ANOVA test was done to assess Lip measurements by smile pattern and Post Hoc (Bonferroni) test was done to analyze the data between patterns. The confidence level was set by 95%, so a p-value less than 0.05 was considered the statistically significant level.

Ethical Measures

The study was approved by ethical committee of Dhaka Dental College Hospital (Ref:DDC/2019/1065, Date: 13.06.2019). There was no physical risk of the patients throughout the study period.

It was a descriptive cross-sectional study; there was no physical risk of the participants throughout the study period. All participants had a case number to maintain their confidentiality. All participants had to sign a written informed consent form. No information was withheld from the participant. No experimental drug or placebo was used. No diagnostic test was required.

Results

This was a cross sectional study. 96 patients were selected from department of orthodontics and dentofacial orthopaedics, Dhaka Dental College hospital, Mirpur -14 through simple random sampling method. The age range was 20 -35 years. Data from each sample was collected from their photographs in rest and maximum social smiling position. The photographic records were analyzed with the software for Windows, Digimizer medicalc 4.2.2.

Internal lip length was measured by using the Modified Esthetic Lip Ruler. The obtained data was analyzed using SPSS version 20.

The average age of the study sample was (26.3±4.7) and out of total sample male participants were 48 (50%) and female participants were 48 (50%).

Age distribution of the study sample was studied and shown in table 1, There were 55.2% study sample between 20-25 years age group, 21.9% between 26-30 years age group, 22.9% between 31-35 age group.

Sex distribution of the study sample was shown in Table 2, Mean age for women was 26.1 years and the men's mean age was 26.4 years.

A statistically significant sexual dimorphism was apparent in many of the measured variables. The result showed that relaxed external upper lip length was 1.24 mm shorter in the women than in men (p=0.005). The resting Vermillion height was 0.62 mm sorter in women than men (p=0.044). The mean maxillary central incisor display at rest was 0.54 mm greater in the women than in men (p=0.039). The maxillary central incisor height was 0.69 mm lesser in females than males (p= 0.003). Internal Upper lip length was 1.75 mm shorter in women than in men (p<0.001). (Table 3)

Sex differences of study parameters at maximum smiling position are showed in Table 4, Smiling External Upper lip length was 1.67 mm lesser in females than in males (p<0.001). The smiling vermillion height was 0.47 mm shorter in female (p=0.015). Maxillary central incisor display during smiling was 0.24 mm more in females than males but it was not found statistically significant. Gingival display was 0.11 mm more in women than in men but it was also found statistically insignificant.

Table-I

Age distribution of the study sample (n=96)

Age group (years)	Frequency	Percentage	Range	Mean±SD
20-25	53	55.2	20-35	26.3±4.7
26-30	21	21.9		
31-35	22	22.9		
Total	96	100.0		

Data were expressed as frequency and percentage and mean±SD

Unpaired student t-test was performed to compare between two groups

ns = not significant

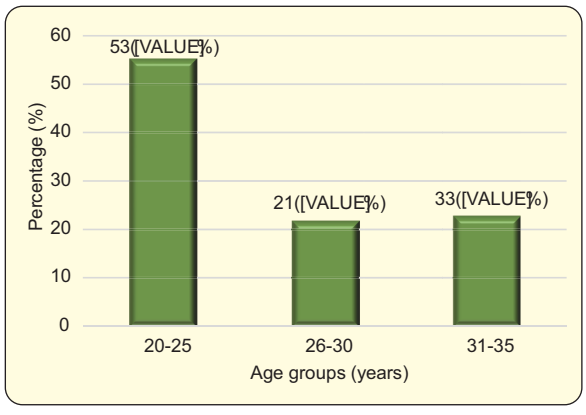

Figure-1: *Bar diagram showing the age distribution of the study sample*

Table-II

Sex distribution of the study sample (n=96)

Age group (years)	Male	Female	Total	p-value
20-25	22(45.8%)	31(64.6%)	53(55.2%)	
26-30	13(27.1%)	8(16.7%)	21(21.9%)	
31-35	13(27.1%)	9(18.8%)	22(22.9%)	0.179[ns]
Total	48(100.0%)	48(100.0%)	96(100.0%)	
Mean±SD	26.4±5.1	26.1±4.4	26.3±4.7	

Figures in the parentheses indicate corresponding percentage;
Chi-squared Test (c^2) was done to analyze the data.
ns = not significant

Among 48 male participants, 22 are within 20-25 years age group, 13 were within 26-30 years age group and 13 are within 31-35 years age group. Among 48 female participants, 31 are within 20-25 years age group, 8 are within 26-30 years age group and 9 are within 31-35 years age group.

All parameters show significant difference between sexes except resting vermillion/external upper lip length ratio.

Table-III

Sex differences of study parameters at rest position (N=96)

Factor	Male (n=48)		Female(n=48)		P value
	Mean (mm)	SD(mm)	Mean (mm)	SD(mm)	
External upper lip length	21.20	2.08	19.96	2.18	0.005[s]
Vermillion height	9.03	1.45	8.41	1.51	0.044[s]
Maxillary central incisor display	2.17	1.28	2.75	1.44	0.039[s]
Internal upper lip length	12.41	2.40	10.66	2.26	<0.001[s]
Maxillary Central incisor height	10.79	0.99	10.10	1.20	0.003[s]
Resting vermillion/external upper lip length ratio	0.43	0.075	0.42	0.067	0.658[ns]
Resting internal upper lip/external upper lip length ratio	0.58	0.119	0.53	0.122	0.044[s]

Data were expressed as mean±SD
Unpaired student t-test was performed to compare between two groups
ns = not significant

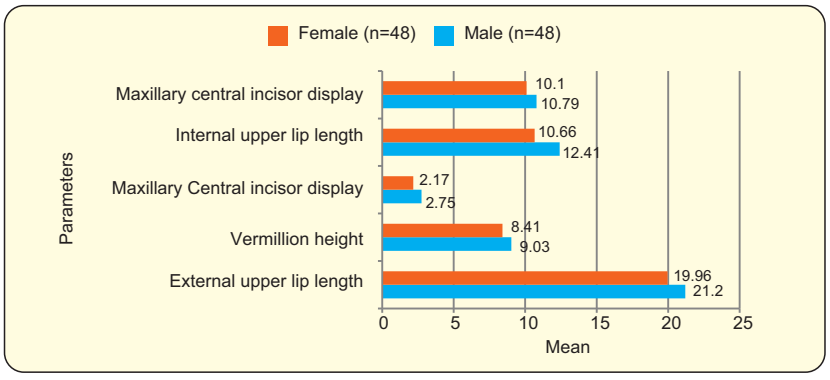

Figure-2: *Bar diagram showing the sex difference of study parameters at rest position*

Table-IV

Sex differences of study parameters at maximum social smile position (N=96)

Factor	Male (n=48)(mm) Mean±SD	Female (n=48) Mean±SD (mm)	p-value
External upper lip length	16.89±2.27	15.22±2.12	<0.001 s
Vermillion height	7.58±1.80	6.71±1.61	0.015 s
Maxillary central incisor display	7.53±2.17	7.77±1.54	0.522 ns
Gingival display	2.34±0.91	2.45±1.09	0.830 ns
Smiling/resting external upper lip length ratio	0.79±0.063	0.76±0.065	0.013 s

Data were expressed as mean±SD
Unpaired student t-test was performed to compare between two groups
ns = not significant

External upper lip length and vermillion height at maximum social smiling position are significantly higher in men than in women. Females are showing a greater prevalence of Gingival display and Maxillary central incisor display while smiling but it is not statistically significant. The smiling/resting external upper lip length ratio is significantly more in men than in women.

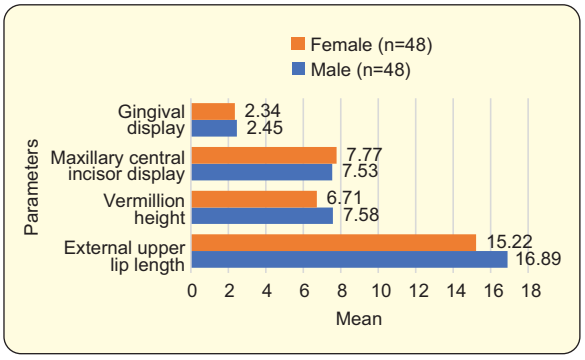

Figure-3: *Bar diagram showing the sex difference of study parameters at smile position*

Discussion

There is no doubt that dentistry is the health profession that deals most with smile enhancement.[24] Recently the topic Cosmetic Dentistry has become important for orthodontists because most of the orthodontic patients evaluate the treatment outcome by their smiles and overall enhancement in their facial appearance.[39]

Measurements of upper lip changes and tooth visibility during rest and smiling position can be measured by both direct method or from still standardized photographs using convenient software. In direct method, measurements are done with slide caliper on face directly at both rest position and when the participant gives a maximum smile. But it is wise to take photograph of the participants both at rest position and at maximum social smiling position and then doing necessary measurements by using appropriate software. If measurements are made directly on face, an individual cannot hold the maximum smile position for the whole time period that the observer requires to record all the measurements. Measuring with the help of software gives more accurate results. Though many authors have used the direct measurement method; photographic method and use of Digimizer medicalc 4.2.2 software was preferred in this present study. Race or ethnicity is a very important factor and play significant role in biologic scaling between sexes. Studies conducted in different countries on different races may show different male and female norms.

In the present study the study sample was 96, and out of total sample 48 were male and 48 were female participants (Table 1) with age ranging from 20-35 years (Table 2).

The upper lip at rest position was 1.24 mm shorter in women than in men, and maxillary incisor display at rest was 2.75 mm in women and 2.17 mm in men. Peck et al[40], Miron et al[17], George D et al[1] found similar results as the present study. The result of the present study demonstrated that Maxillary central incisor clinical crown height was 0.7 mm shorter in females than in males which is similar to the study done by peck et al[40]. Other authors[3,17,41] found it a little less than the difference observed by the current study. The internal upper lip

length comprised 53.40% of the external upper lip in women and 58.54% in men which was slightly less than the observation by Miron et al.[17] Like the other studies, present study also found that the upper lip intraoral attachment at the labial vestibule was less in the women relative to the men. Upper lip vermillion height comprised 47% of the whole upper lip length in female and 40% in male participants which was similar with the findings mentioned in the other studies.[3,25,42] In this study, the upper lip length was found 20% shorter at maximum smiling relative to the resting position in male participants where in female participants it was 23% shorter. This finding was slightly different from the study conducted by Miron et al.[17] They observed that the upper lip length was 27% shorter in maximum smiling relative to the resting position in both sexes. Data obtained from this study (Table 3) in concordance with other studies[3,17,40,41,43] 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 result of the present study (Table 4) demonstrated that smiling external upper lip length and vermillion height were found significantly lesser in women than in men which is similar with the study conducted by Miron et al[17], George D et al[3] and Singh S et al.[41] In this study, maxillary central incisor display at smiling position was found 7.77 mm in females and 7.53 mm in males. In other studies[3,17,41], these data between sexes were more evident than the current study. Sexual dimorphism was clearly evident in lip and tooth measurements at maximum smiling position.

Grover et al[44] observed that the smile parameters in vertical dimensions (vertical aspects of smile anatomy, tooth display, upper lip drape and gingival display) were increased in vertical facial growth pattern group. Rizvi HM and Hossain MZ[45] studied on Bangladeshi young adults and established Cephalometric norms of young adults of Bangladesh (Steiner's analysis). They found that Bangladeshi people have a more prominent Horizontal growth when compared with the Coccasians. There was no significant difference in the means between the male and female participants.

Conclusion

Data from this study clearly indicated sexual dimorphisms in upper lip length, maxillary central incisor display and labial vestibular insertion. Males and females show subtle differences in certain lip parameters. This should be kept in mind while planning treatment.

Lip parameters for Bangladeshi population divided for gender as obtained in this study, will be very useful for Orthodontists and dentists in order to obtain ideal anterior aesthetics after treatment.

Conflict of interest: None

References

1. Tatakis DN, Paramitha V, Lu WE, Guo X. Upper lip characteristics and associated excessive gingival display etiologies in adults: Race and sex differences. J Periodontol 2024;95:74–83.
2. Trang NDQ, Man TT, Minh NV, Thao NP. Morphology and personal perception of excessive gingival display in anterior maxillary teeth. Hue Journal of Medicine and Pharmacy 2025;15(4) :27-33
3. George D, Kamath P, Arun BR, Scindhiya R, Raghuraj Mb. Vertical Dimensional Change Analysis during Smile: A Survey Study. International Journal of Applied Dental Sciences 2015;1(4):152-155.
4. Sachdeva K, Singla A, Mahajan V, Jaj HS, Negi A. Esthetic and Smile Characteristics at Rest and during Smiling. J Ind Orthod Soc 2012;46(1):17-25.
5. Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. J Prosthet Dent 1984;51:24-8.
6. Sepolia S, Sepolia G, Kaur R, Gautam DK, Jindal V, Gupta SC. Visibility of gingiva - An important determinant for an esthetic smile. J Indian Soc Periodontol 2014;18:488-92
7. Miller A G. Role of physical attractiveness in impression formation. Psychological Science 1970;19:241–243
8. Geld PV, Paul Oosterveld, Kuijpers-Jagtman AM. Age-related changes of the dental aesthetic zone at rest and during spontaneous smiling and speech. Eur J Orthod 2008;30: 366-73.
9. Kiekens RM, Maltha JC, van't Hof MA, Kuijpers Jagtman AM. Objective measures as indicators for facial esthetics in white adolescents. Angle Orthod 2006;76:551-6.
10. Maniyar M, Kalia A, Mirdehghan N, Nene S, Bhagwagar P. Evaluation of the influence of gingival display on smile aesthetics in Indian females-a computer-aided photographic analysis. J Indian Orthod Soc 2018;52:100-5.
11. Loi H, Nakata S, Counts AL. Influence of gingival display on smile aesthetics in Japanese. Eur J Orthod 2010;32:633-7.
12. Agrawal N, Sable RB. Correlation of upper lip morphology to smile: A photographic study. APOS Trends Orthod 2015;5:133-7.
13. Van der Geld P, Oosterveld P, van Heck G, Kuijpers-Jagtman AM. Smile attractiveness: self-perception and influence

on personality. Angle Orthod 2007;77:759-65.

14. Maulik C, Nanda R. Dynamic smile analysis in young adults. Am J Orthod Dentofacial Orthop 2007;132:307-15.
15. Chakroborty G, Pal TK, Chakroborty A. A study on gingival component of smile. J Int Clin Dent Res Organ 2015;7:111-5.
16. Garber DA, Salama MA. The aesthetic smile: diagnosis and treatment. Periodontol 2000;1996:18-28.
17. Miron, Calderon, and Allon. Upper lip changes and gingival exposure On smiling: Vertical dimension analysis. Am J Orthod Dentofacial Orthop 2012;141:87-93.
18. Roget's II. The New Thesaurus. 3rd ed. Available at http://www.answers.com/topic/smile. Accessed January 1, 2006.
19. Sethna GD, Parmer HM, Gaikwad RP, Nabazza SS. Objective smile analysis and its relationship with the lip length in an Indian population–An institution based study. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 2019;18(2):67-75.
20. Rigsbee OH, Sperry TP, Begole E. The influence of facial animation on smile characteristics. Int J Adult Orthod Orthognath Surg 1988;3:233-39.
21. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. Am J Orthod Dentofacial Orthop 2003;124:116-27.
22. Ackerman JL, Ackerman MB, Brensinger CM, Landis JR. A morphometric analysis of the posed smile. Clin Orthod Res 1998;1:2-11.
23. Sarver DM. The importance of incisor positioning in the esthetic smile: The smile arc. Am J Orthod Dentofacial Orthop 2001;120:98-111.
24. Dayakar MM, Shipilova A, Rekha M. Evaluation of smile esthetics by photographic assessment of the dento-labio-gingival complex. J Dent Allied Sci 2015;4:65-8.
25. Desai S, Upadhyay M, Nanda R. Dynamic smile analysis: Changes with age. Am J Orthod Dentofacial Orthop 2009;136:310.e1-e10.
26. Morley, J. and Eubank, J. Macroesthetic elements of smile design. J. Am. Dent. Assoc 2001;132:39-45.
27. Peck S, Peck L, Kataja M. The gingival smile line. Angle Orthod. 1992;62:91–100.
28. Mackley, R.J. "Animated" orthodontic treatment planning. J. Clin. Orthod. 1993;27:361-365.
29. Vandergeld P, Oosterveld P, Berge SJ, Jagtman AM. Tooth display and lip position during spontaneous and posed smiling in adults. Acta Odontologica Scandinavica 2008;66:207-213
30. Berg R. Orthodontic treatment - yes or no? A difficult decision in some cases. A contribution to the discussion. J Orofac Orthop 2001;62:410-21.
31. Tosun H, Kaya B. Effect of maxillary incisors, lower lip, and gingival display relationship on smile attractiveness. American Journal of Orthodontics and Dentofacial Orthopedics 2020;157(3):340-347.
32. Batwa W, Hunt NP, Petrie A, Gill D. Effect of occlusal plane on smile attractiveness. Angle Orthod 2012;82:218-23.
33. Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent 1999;11:311-24.
34. Ritter DE, Gandini LG Jr, dos Santos Pinto A, Ravelli DB, Locks A. Analysis of the smile photograph. World J Orthod 2006;7:279-85.
35. Langlois JH, Kalakanis L, Rubenstein AJ, Larson A, Hallam M, Smoot M, et al. Maxims or myths of beauty? Meta-analytic and theoretical review. Psychol Bull 2000;126:390-423.
36. Howells, David J. The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. Am J Orthod. 1985; 88:402-408.
37. Janzen EK. A balanced smile—a most important treatment objective. Am J Orthod 1977;72:359-72.
38. Hasan MM, Hossain MZ. Smile characteristics of Bangladeshi young adults: a video graphic evaluation. J Cont Dent Sci 2017;5(2):1-6
39. Isiksal E, Hazar S, Akyalcin S. Smile esthetics: Perception and comparison of treated and untreated smiles. American Journal of Orthodontics and Dentofacial Orthopedics 2006;129:8-16.
40. Peck S, Peck L, Kataja M. Some vertical lineaments of lip position. Am J Orthod Dentofacial Orthop 1992;101:519-24.
41. Singh S, Garg H, Sharma R, .Dhiman S. Upper Lip Soft Tissue Changes And Gingival Display On Smiling: A Study Of Vertical Dimension. Indian Journal of Dental Sciences 2015;7(1):051-053.
42. Perenack J. Treatment options to optimize display of anterior dental esthetics in the patient with the aged lip. J Oral Maxillofac Surg 2005;63:1634-41.
43. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent. 1978; 39:502-504.
44. Grover et al. Smile analysis in different facial patterns and its correlation with underlying hard tissues. Progress in Orthodontics 2015;16:28.
45. Rizvi HM, Hossain MZ. Cephalometric norms of young adults of Bangladesh (Steiner's analysis)- priliminary report. Bangladesh Journal of Orthodontics and Dentofacial Orthopedics (BJO and DFO) 2011;2:11-15.