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Evaluation of smile parameters in growing and non-growing individuals - A photographic study

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Abstract

Aims and Objectives, of Study: To evaluate the static norms for various smile parameters in growing and non-growing individuals and to analyze and quantify the sexual dimorphism of smile parameters.

Material and Methods: study was to evaluate the smile parameters namely buccal corridor ratio, smile breadth in growing and non- growing individuals. Frontal smiling photographs of 100 individuals were divided into two groups, GROUP A consisted 50 growing individuals in which 25 male and 25 female individuals, GROUP B consisted of 50 Non growing individuals in which 25 males and 25 females individuals. Buccal corridor, smile index and smile breadth ratios photographs.

Results: Buccal corridor ratio in esthetically pleasing growing male was 6.9 % and in growing female was 8.3% and in non-growing male was 9.2 %, in non – growing female was 11.2%. Smile Index in growing male was 4.290 and in growing female was 6.023 and in non-growing male was 6.225 and non-growing female was 6.770. Smile breadth growing male was 0.512 and in female was 0.526 in non -growing female was 0.501 and in non-growing male was 0.456.

Conclusion: This smile parameter are esthetically important and must be considered in determining and executing appropriate individual treatment goal especially in decision making of extraction and expansion.

Keywords: Esthetics, Smile, Buccal Corridor.

Introduction

Physical attractiveness plays an important role on people's perception or on their own understanding. Most of the patients seek orthodontic treatment not only to gain well-aligned teeth but also to improve their facial esthetics. They are demanding an appearance that is physiologically and mechanically sound with esthetically attractive teeth.

Dentofacial attractiveness is a major determinant of overall physical attractiveness. Smile ranks second only to the eyes as the most important feature in facial attractiveness.

Orthodontic patients and their parents expect that orthodontic treatment will improve their dentofacial aesthetics and consequently their popularity and social acceptance. Recently the field of orthodontics has experienced a "paradigm shift" to focus more on aesthetics with specific emphasis to the peri-oral soft tissues.

The 'father of orthodontics' Edward H. Angle referred to the profile of the Greek statue of Apollo Belvedere as "a face so perfect in outline that it has been the model for students of facial art. In the early 1900s Mathew Cryer, a professor of Oral Surgery at the University of Pennsylvania and Calvin Case also believed that the esthetic harmony of the face should be the most important objective in orthodontic treatment, and that extraction of teeth was sometimes necessary to achieve that goal.

Recently Orthodontic treatment objectives are aimed at three types of **Dental Smile Esthetics: -** Macro esthetics, Mini esthetics and Micro esthetics. Macro esthetics attempts to identify and analyze the relationship and ratio between anterior teeth and surrounding tissue landmark. Mini Esthetics consideration includes smile type, smile arc and buccal corridors. Micro esthetics includes tooth proportions, connector's area & embrasures, tooth shade & color gingival height, shape & contours. Hence, orthodontic treatment must incorporate various esthetic elements to achieve desirable results.

Since Smile plays an important role in esthetics, one of the most important goals in orthodontics is to achieve a balanced smile which can be best described as an appropriate positioning of teeth and gingival scaffold within the dynamic display zone.

A Balanced Smile has eight components which are lip line, smile arc, upper lip curvature, buccal corridor, smile symmetry, frontal occlusal plane, dental components, gingival components.

Many studies have been conducted to evaluate the various smile components like-

1. Frush and Fischer demonstrated that the presence of buccal corridors added the illusion of a natural dentition, whereas its absence gave the patient an artificial appearance. Studies have shown that minimal buccal corridor is a preferred esthetic feature in both men and

women and large buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning.

2. Ackerman and Ackerman developed a ratio called the smile index used to visualize and quantify the frontal smile. [13] This ratio is used for comparing smiles among patients. The lower the smile index the less youthful the smile appears.

Orthodontists have to make every effort to develop a harmonious balance between the various soft and hard tissue structures to produce an attractive smile.

The objective of this study is to analyze these three parameters of individuals with pleasing smiles; which can be standardized for orthodontic treatment planning. Which are:-

1. Buccal corridor index,
2. Smile index and
3. Smile breadth

Both orthodontists and lay-persons are able to use visual analogue scales (VAS) to judge facial aesthetics from photographs in a more or less intuitive way, although facial aesthetics seem to be subjective.

Fig 1: Smile

Materials and Method

Source of data - Photograph of 100 individuals were taken from Department of Orthodontics & Dentofacial Orthopaedics of KD Dental College will be selected for this study.

These individuals were divided into **2 groups**:

Group A - 50 growing individuals out of which 25 were male individuals and 25 were female individual's ranges in the age group upto 16 years.

Group B - 50 non growing individuals out of which 25 were male individuals and 25 were female individual's ranges in the age group of 17 -29 years.

Inclusive Criteria

Extra oral: No facial asymmetry, Smile symmetry present, Well-proportioned upper and lower facial height, Straight profile, Normo-divergent face pattern, Competent lips, Average upper lip line with 75% - 100% maxillary teeth exposure on smiling, Consonant smile with positive upper lip curvature

Intra oral: Class I molar relationship, Complete permanent dentition except for 3rd molar, No crowding in upper arch and minimal crowding acceptable in lower arch, No other oral pathology, No missing teeth, No supernumerary teeth, Absence of periodontal disease, No proclination of maxillary incisor, No cant in frontal occlusal plane, No midline deviation.

History: No history of orthodontic treatment, No history of periodontal treatment except scaling and root planning, No history of prosthetic treatment.

Standardization and Calibration of photographs: Clinically measurement between two point subnasale to soft tissue menton during smile was taken for calibrating the photograph in the software.

Static photographs with posed smile in natural head position (NHP) were taken.

All photographs were taken in a similar environment and lighting conditions using canon 1300 DSLR camera which was mounted on a tripod stand at a fixed distance of 20 inches. Focal length of 38 mm was set.

The lens was positioned parallel to the true perpendicular of the face in natural head position and the

camera was raised to the level of individual's lower facial third.

The individuals were asked to say "cheese" and then smile. Vertically, the photographs cropped from sub nasale and soft tissue pogonion. Horizontally, the photographs were cropped by drawing a tangent on both the sides of the face at the zygomatic prominence.

Fig 2: 1300 DSLR camera with lens

Fig 3: Static photographs with posed smile taken in Natural Head Position (NHP)

The images were transferred to computer software (KLONK image measurement) and then the images were calibrated taking two point's subnasale and soft tissue menton. The distance between these two points were calibrated equal to the clinical measurement.

Fig 5 : Photograph cropped vertically from subnasale and soft-tissue pogonion and horizontally by drawing a tangent on both the sides of the face at the zygomatic prominence

After calibration, the measurements taken for the study were as follows:

Visible maxillary dentition width (A) - distance between the most posterior visible teeth of one side to the contralateral side.

Inner commissure width (B) - inner corner of the lips on one side to the same point on the contralateral side.

Outer commissure width (C) - outer corner of the lips on one side to the same point on the contralateral side.

Bizygomatic width (D) - between the most lateral points on the external surfaces of the zygomatic arch.

Inter labial gap (E) - the distance in mm between the upper and lower lips at midline.

In addition to the linear measurements following ratios were derived. These ratios are as follows:

Buccal corridor ratio- a ratio of dark space at the corner of the mouth and inner commissure width **(B-A/B)**

Smile index - a ratio of inner commissure width and inter labial gap **(B/E)**

Smile breadth - a ratio of outer commissure width and bizygomatic width **(C/D)**.

All these linear measurements were taken on every individuals photograph; ratios were derived and sent for statistical analysis.

Color Plate-1

Fig 6: Visible Maxillary dentition Width (A)

Fig 7: Inner Commissure Width (B)

Fig 8 : Outer Commissure Width (C)

Fig 9: Bizygomatic width (D)

Fig 10: Inter labial Gap (E)

Statistical Analysis

The Shapiro–Wilk test was used to investigate the distribution of the data

Levene's test to explore the homogeneity of the variables.

Independent t-test used to determine if two sets of data are significantly different from each other, and is most commonly applied when the test statistic would follow a normal distribution.

Result

Gender wise comparison of Group A and Group B

1. There was no statistically significant difference found in interlabial gap and smile breadth of growing and non-growing males for P value < 0.001

2. In growing and non-growing females there was statistically significant difference found only in buccal corridor space and buccal corridor ratio for P value < 0.001.

3. In genderwise comparison of smile parameters measurements in growing individuals found that there is significant difference in Interlabial gap and Smile index for P value < 0.001 .

4. In genderwise comparison of smile parameters measurements in non-growing individuals found that there is no significant difference in Smile breadth for P value < 0.001

Table 1: Genderwise comparison of smile parameters measurements in growing individuals

Study parameters	Groups	N	Mean	SD	SEM	t value	p value
Width	Males	25	43.639	3.317	0.663	-1.316	0.180 (Non-Sig)
	Females	25	44.762	2.459	0.491		
Inner Commissure Width	Males	25	46.546	3.097	0.619	-2.591	0.062 (Non-Sig)
	Females	25	48.584	2.425	0.485		
Outer Commissure Width	Males	25	56.672	2.489	0.497	-0.701	0.486 (Non-Sig)
	Females	25	57.162	2.446	0.489		
Bizygomatic Width	Males	25	113.182	6.149	1.229	-0.531	0.538 (Non-Sig)
	Females	25	114.232	7.742	1.548		
Inter labial Gap	Males	25	9.826	2.252	0.450	-4.253	0.001 (Sig)
	Females	25	7.506	1.539	0.307		
Buccal Corridor Space	Males	25	2.707	0.773	0.154	-2.312	0.059 (Non-Sig)
	Females	25	3.575	0.750	0.150		
Buccal Corridor Ratio	Males	25	0.069	0.013	0.002	-2.315	0.058 (Non-Sig)
	Females	25	0.083	0.009	0.001		
Smile Index	Males	25	4.290	0.723	0.144	-8.327	0.001 (Sig)
	Females	25	6.023	0.674	0.134		
Smile Breadth	Males	25	0.512	0.161	0.032	-0.355	0.724 (Non-Sig)
	Females	25	0.526	0.102	0.020		

Graph 1: Genderwise comparison of various smile parameter ratios among growing Individuals

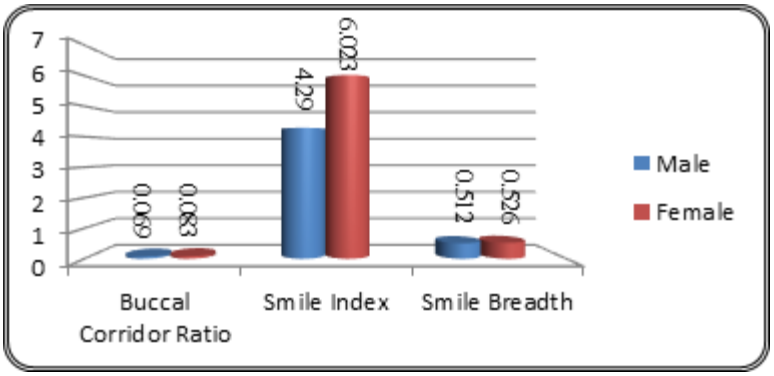


Table 2: Genderwise comparison of smile parameters measurements in non-growing individual

Study parameters	Groups	N	Mean	SD	SEM	t value	p value
Width	Males	25	48.936	3.316	0.663	-6.144	0.001 (Sig)
	Females	25	43.797	2.312	0.462		
Inner Commissure Width	Males	25	51.543	3.111	0.622	-3.171	0.001 (Sig)

	Females	25	49.827	2.435	0.487		
Outer Commissure Width	Males	25	61.054	2.597	0.519	-4.047	0.001 (Sig)
	Females	25	58.166	2.446	0.489		
Bizygomatic Width	Males	25	123562	6.559	1.311	-3.069	0.001 (Sig)
	Females	25	119.202	7.610	1.522		
Inter labial Gap	Males	25	9.211	2.249	0.449	-1.783	0.001 (non-Sig)
	Females	25	7.193	1.431	0.286		
Buccal Corridor Space	Males	25	3.868	0.501	0.100	-9.919	0.001 (Sig)
	Females	25	5.400	0.587	0.117		
Buccal Corridor Ratio	Males	25	0.092	0.010	0.002	-7.773	0.001 (Sig)
	Females	25	0.112	0.007	0.001		
Smile Index	Males	25	6.225	0.720	0.144	-2.569	0.001 (Sig)
	Females	25	6.770	0.680	0.136		
Smile Breadth	Males	25	0.456	0.162	0.032	-1.286	0.205 (Non- Sig)
	Females	25	0.501	0.064	0.012		

Graph 2: Genderwise comparison of various smile parameter ratios among Non-growing Individuals

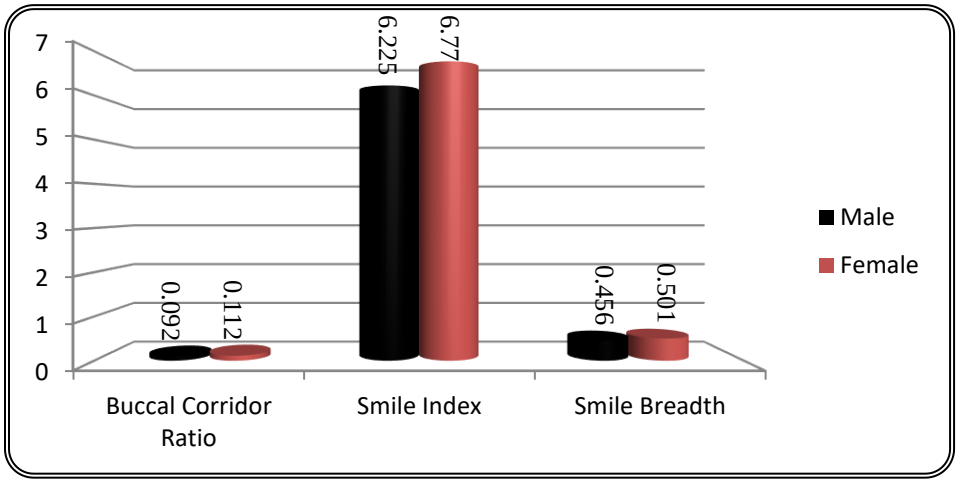
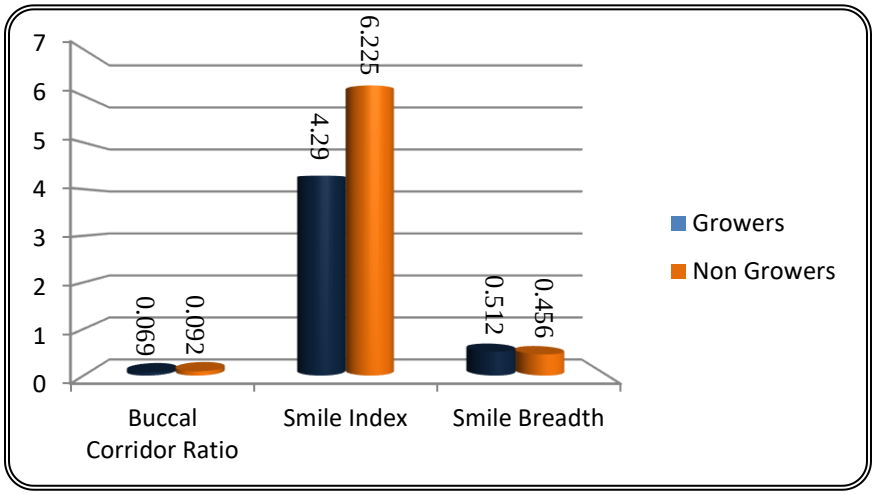


Table 3: Intergroup Comparison between growing and non- growing male individuals using independent student t Test

Study parameters	Groups	N	Mean	SD	SEM	t value	p value
Width	Growers	25	43.639	3.317	0.663	-5.546	0.001(Sig)
	Non-Growers	25	48.936	3.362	0.662		
Inner Commissure Width	Growers	25	46.546	3.097	0.619	-5.591	0.001 (Sig)
	Non-Growers	25	51.543	3.111	0.622		
Outer Commissure Width	Growers	25	56.672	2.489	0.497	-6.089	0.001 (Sig)
	Non-Growers	25	61.054	2.597	0.519		

Bizygomatic Width	Growers	25	113.182	6.149	1.229	-5.461	0.001 (Sig)
	Non-Growers	25	123.562	6.559	1.311		
Inter labial Gap	Growers	25	9.826	2.252	0.450	-0.969	0.339 (Non-Sig)
	Non-Growers	25	9.211	2.249	0.449		
Buccal Corridor Space	Growers	25	2.707	0.773	0.154	-6.230	0.001 (Sig)
	Non-Growers	25	3.868	0.501	0.100		
Buccal Corridor Ratio	Growers	25	.069	0.013	0.002	-9.228	0.001 (Sig)
	Non-Growers	25	.092	0.010	0.002		
Smile Index	Growers	25	4.290	0.723	0.144	-9.470	0.001 (Sig)
	Non-Growers	25	6.225	0.720	0.144		
Smile Breadth	Growers	25	0.512	0.161	0.032	-2.674	0.020 (Sig)
	Non-Growers	25	0.456	0.162	0.038		

Graph 3: Comparison of various smile parameter ratios between Growing and Non-growing Male Individuals



Graph 4: Comparison of various smile parameter ratios between growing and Non-growing female Individuals

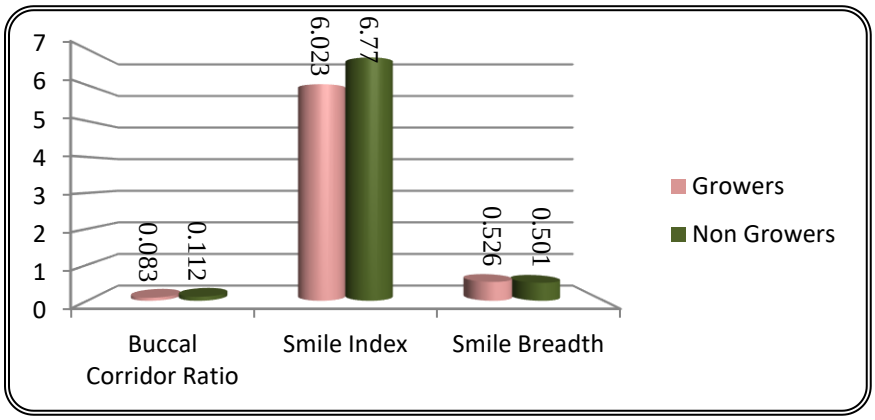


Table 4: Intergroup Comparison between growing and non- growing female individuals using independent student t Test

Study Parameters	Groups	N	Mean	SD	SEM	t value	P value
Width	Growers	25	44.762	2.459	0.491	1.430	0.159 (Non-Sig)
	Non-Growers	25	43.797	2.312	0.462		
Inner Commissure Width	Growers	25	48.584	2.425	0.485	-1.808	0.077 (Non-Sig)
	Non-Growers	25	49.827	2.435	0.487		
Outer Commissure Width	Growers	25	57.162	2.446	0.489	-1.450	0.154 (Non-Sig)
	Non-Growers	25	58.166	2.446	0.489		
Bizygomatic Width	Growers	25	114.232	7.742	1.548	-2.289	0.057 (Non-Sig)
	Non-Growers	25	119.202	7.610	1.522		
Inter labial Gap	Growers	25	7.506	1.539	0.307	743	0.461 (Non-Sig)
	Non-Growers	25	7.193	1.431	0.286		
Buccal Corridor Space	Growers	25	3.575	0.750	0.150	-9.575	0.001 (Sig)
	Non-Growers	25	5.400	0.587	0.117		
Buccal Corridor Ratio	Growers	25	0.083	0.009	0.001	-12.156	0.001 (Sig)
	Non-Growers	25	0.112	0.007	0.001		
Smile Index	Growers	25	6.023	0.674	0.134	-1.894	0.126 (Non-Sig)
	Non-Growers	25	6.770	0.680	0.136		
Smile Breadth	Growers	25	0.526	0.102	0.020	1.028	0.309 (Non-Sig)
	Non-Growers	25	0.501	0.064	0.012		

Discussion

Smile plays an important role in facial expression and appearance. Several studies have been conducted using photographs and they denote that higher intellectual and social abilities were attributed to individuals with good esthetics. One of the most important objectives of orthodontic treatment is to improve facial attractiveness, which is achieved by the enhancement of dental and smile esthetics.

In our study the mean score of **inter labial gap** in growing male was 9.826 mm and in growing female was 7.506 and in non-growing male was 9.211 mm and in non-growing female was 7.193 mm . The results of our study are not in accordance with study done by desai [58] et al who found 10.27 mm of inter-labial gap which is towards higher side. The results of our present study show that inter-labial gap decreases with age which are in accordance with the study done by Desai et al. [58]

Hence; it was concluded in our study that the people who are having esthetically pleasing smile have less buccal corridor ratio. There was significant difference between non-growing male individuals and non-growing female individuals but no significant difference was found between growing males and growing female individuals. The mean score of **buccal corridor ratio** in non-growing male individuals was 0.092 mm (9.2%) and in non- growing female individuals was 0.112mm (11.2%) whereas in growing male individuals was 0.069 (6.9%) and in growing female individuals was 0.083 (8.3%) . Non- growing male individuals were having less buccal corridor ratio as compare to non- growing female individuals and growing males individuals were

having less buccal corridor ratio as compare to growing female individuals. Growing individuals were having less buccal corridor ratio as compare to non – growing individuals.

The results of this study are in agreement with the study done by Parekh et al [16] who found that excessive buccal corridor and smile arcs were rated less attractive by both orthodontist and lay-person. Our findings are also in agreement with Huma Kiani Et Al [32] who demonstrated that broader smiles with minimum buccal corridor space were preferred by both orthodontist and laypersons. The findings of our study are not in accordance with the study done by Diana Cunha et al [29] who considered 16 % buccal corridor ratio as the most pleasant one. The reason for that may be attributed to the fact that they have taken the distance between outer commissure widths for measuring the buccal corridor ratio whereas in our study the distance between inner commissure was taken.

In this study, the mean score of **smile index** in non-growing male was 6.225 mm and in non-growing female was 6.770 mm. The mean score of smile index in growing males was 4.209 mm and in growing females was 6.023 mm. There was no statistically significant difference between non-growing male and non-growing female, but there was statistically significant difference growing males and growing females. The results of the study are also in accordance by Parekh et al [16] who found the smile index was 6.0212mm.

In the present study **smile index** is more for non-growing individuals as compared to growing individuals which is supported by Desai et al. [58] According to their study the smile index significantly increased with age. This data provides evidence that, as a person ages, the smile tends to get relatively wider transversely and narrower vertically. This can be attributed to activity and function of the muscles involved in smile decrease with age. The findings of our study are also supported by Chetan et al. [59]

The mean score of **smile breadth** in non-growing male was 0.456 mm and in non-growing female individuals was 0.501 mm. There was statistically significant difference between non-growing male and non-growing female. The mean score of smile breadth in growing male was 0.512 mm and in growing females was 0.526 mm. There was no statistically significant difference between growing males and growing female individuals. In the present study smile breadth was more for growing individuals as compare to non-growing individuals.

Although our study is limited on virtue of being a cross-sectional study. Longitudinal data derived from dynamic smile recording of growing individuals would provide a better insight into the smile parameters and their changes with age.

Conclusion

Based on the results; conclusions are:

1. In growing individuals Inter-labial gap was more in esthetically pleasing male as compared to females.
2. In growing individuals Smile Index was more in females as compared to males.
3. In non- growing individuals Visible maxillary posterior teeth width was more in male as compared to females.
4. In non- growing individual's Inner commissure and outer commissure width was more in male as compared to females.
5. In non- growing individuals Bizygomatic width was more in male as compared to females.
6. In non- growing individuals Buccal Corridor Ratio was more in females as compared to males.
7. In non- growing individuals Smile Index was more in females as compared to males.

8. Visible maxillary posterior teeth width increased with age in males.

9. Inner commissure and outer commissure width in esthetically pleasing males was increased with age in males.

10. Bi-zygomatic width in esthetically pleasing males was increased with age.

11. Buccal corridor ratio in esthetically pleasing non – growing male was 9.2 %, in non – growing female was 11.2%, in growing male was 6.9 % and in growing female was 8.3%. Buccal corridor ratio increased with age in both males and females.

12. In males Smile index increased with age which indicates that smile tends to get relatively wider transversely and narrower vertically.

13. In males Smile breadth decreased with age which indicates bizygomatic width increases more as compare to outer commissure width is almost 50% of bi-zygomatic width.

14. Our treatment goal should be to achieve the smile parameters that are ideal or closer to these values for optimal smile esthetics.

Clinical Implication

1. Less buccal corridor space has been preferred in esthetically pleasing smile, which should be considered during treatment planning involving extraction or expansion.

2. In our study, smile index of esthetically pleasing individuals indicates that the width of inner commissure is almost six times than that of inter labial gap.

3. These important esthetic parameters must be considered in determining and executing appropriate individual treatment goal especially in decision making of extraction and expansion.

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