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Research Article

BUCCAL CORRIDOR AND IT'S EFFECTS ON SMILE ESTHETICS IN HYDERABAD POPULATON-AN INVITRO STUDY

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ABSTRACT

Optimal facial esthetics is one of the objectives in orthodontic treatment. The purpose of this study was to measure and verify the esthetic influence of the buccal corridors (negative or black spaces) during smile. The material consisted Frontal smile photographs of 10 adults (5 females, 5 males) of native Hyderabad population. The overall plan was to alter the amount of buccal corridor space in the subject's smiling images and to have these images judged for smile attractiveness by a panel of Laypeople, Orthodontists, and Fashion technology experts (Each group includes 5 male judges and 5 female judges). A consistent relationship between smile fullness (buccal corridor) and smile attractiveness was shown in this study. On average, broad smile fullness was rated the best, followed by medium-broad fullness, medium fullness, and medium-narrow smile fullness. Narrow smile fullness was rated least attractive.

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INTRODUCTION

Smile analysis and smile design have become key elements of orthodontic diagnosis and treatment planning over the last decade (Marc B. Ackerman et al, 2002)¹. An important smile feature is the presence or absence of buccal corridors. In 1958, Frush and Fisher defined Buccal corridors (negative or black spaces) as the spaces between the facial surfaces of posterior teeth and the corners of lips when a person is smiling (Frush et al, 1958)². Buccal corridor has been classified as a mini esthetic feature of the smile, which is influenced by the macro esthetic feature of facial type (Marc B. Ackerman, 2005)³. The presence of the buccal corridor avoids the so-called "16 teeth smile" or "piano smile," which characterizes a full mouth total prosthesis (Daltro Enéas Ritter et al, 2006)⁴.

The buccal corridor space has captured the attention of clinicians because they are within the realm of orthodontic treatment control, and they can easily be related to other concepts of orthodontic diagnosis and treatment such as arch

form and width, gnathologic concepts of occlusal function, and the extraction/ nonextraction controversy.

Hence this study was undertaken with the aim of evaluating the influence of buccal corridor on smile attractiveness and comparing the differences between perceptions of smile when evaluated by orthodontists, laypeople and fashion technology experts.

MATERIAL AND METHODS

Selection of Sample: The material consisted Frontal smile photographs of 10 adults (5 females, 5 males) of native Hyderabad population. The age ranged between 18 to 25 years. The sample selection was done based on the following criteria:
1) Acceptable, mesoprosopic facial form and pleasing profiles
2) All the subjects who had completed their active physical growth
3) Class I molar relationship on both the sides, with normal overjet and overbite
4) Absence of gross facial asymmetry or deformity
5) No history of previous Orthodontic or Prosthodontic treatment or facial surgery
6) The sample

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included both male and female sexes in equal numbers to evaluate the significant morphological differences between them. The photographic setup consisted of a tripod (fig 1) that held a 35-mm camera with a 100mm macrolens and a primary flash. For illumination during photography, umbrella flashes were used.

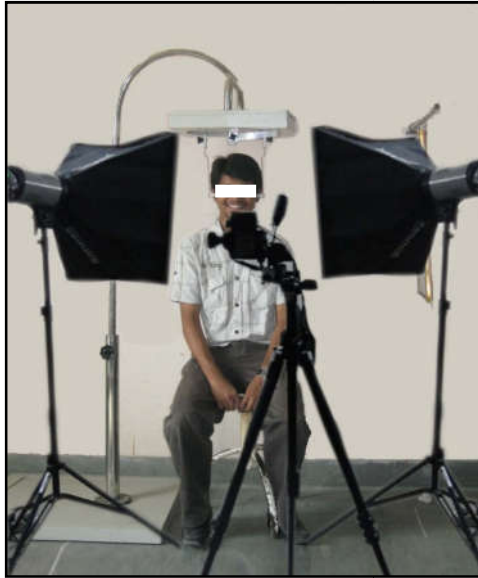


Fig 1 Photographic set up

Standardization of the photographs was achieved by: 1) Maintaining a constant distance between the subject and the camera. Camera to subject distance was standardized at 1.5 meters. The camera was used in its manual position, the shutter speed was 1/125 second, and the opening of the diaphragm was f/112) A constant zoom level is also retained 3) the same camera was used to click all photographs. 4) The same operator clicked all the photographs (for further refinement, though this would make a negligible difference) 5) Finally to eliminate any errors, buccal corridor and smile fullnesses were calculated as percentages of the inner commissure width. Because the dentition can maximally fill only to the innermost aspect of the commissure, we calculated the buccal corridor and smile fullness as ratios of the inner commissure width. (fig 2).

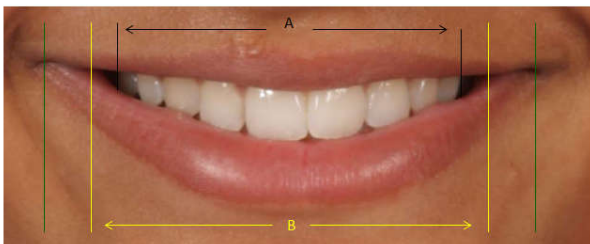


Figure 2 Showing outer and inner commissure

Measurement of buccal corridor and smile fullness was done as follows (fig 3). Smile fullness was calculated as visible maxillary dentition width (A) divided by inner commissure width (B). Buccal corridor was calculated as difference

between visible maxillary dentition width and inner commissure width divided by inner commissure width. Both ratios were reported as percentages. The sum of the 2 ratios for a given image equals 100%.



Figure 3 Measurement of buccal corridor and smile fullness

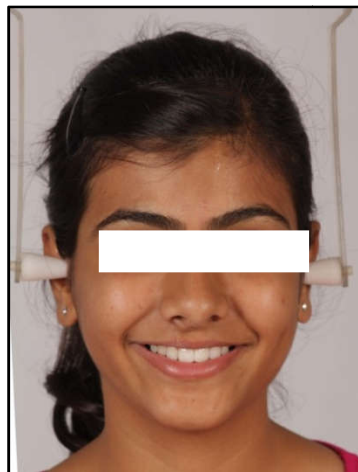
To produce the varying sizes of buccal corridors, the resulting images were imported into Adobe Photoshop version CS2 and all images set to the same magnification. To preserve a realistic appearance inter-canine width is unaltered. This width is on an average 75% of the inner commissure width. Five altered images were created for each of the 10 subjects to produce a range of 5 smile fullnesses: Narrow (28% buccal corridor), Medium-Narrow (22% buccal corridor), Medium (15% buccal corridor), Medium-Broad (10% buccal corridor), and Broad(2% buccal corridor).



Broad smile fullness



Medium-Broad smile fullness



Medium smile fullness



Medium-Narrow smile fullness



Narrow smile fullness

Fig 4 Representative female subject illustrating the range of smile fullnesses generated

The only difference between the altered images of the same subject is the amount of buccal corridor. Consequently, the effects of all other variables (eg. Minor differences in head position, amount of incisor display) were eliminated.

Next, each altered image was paired with another altered image of the same subject. In other words, a series of paired images of the same subject was displayed to the panel of judges. There are 11 possible combinations of pairings for each subject:

narrow V/s medium-narrow, narrow V/s medium, narrow V/s medium broad, narrow V/s broad, medium-narrow V/s medium, medium-narrow V/s medium-broad, medium-narrow V/s broad, medium V/s medium-broad, medium V/s broad, medium broad V/s broad, and randomly selected identical pairings, such as medium V/s medium. The pairings were sorted randomly for both sequence and left-right positioning. The pairings were then placed into a Microsoft Power Point slide show for display to the panel.

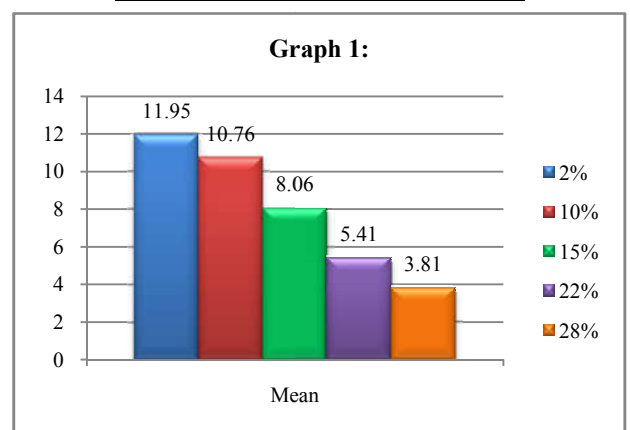
The panel consisted of 10 laypeople, 10 Orthodontists, 10 fashion technology experts. The judges were instructed to choose the smile they preferred from each pairing and mark their opinion as left much better, left better, same, right better, or right much better. A point system, based on response to each pairing, was used to establish a score for each increment of buccal corridor width. The mean score was computed for each combination of subject image and judge.

RESULTS

ANOVA with “Bonferroni test” was applied to all variables to determine the difference between the scores of the five different smile fullnesses. A consistent relationship between smile fullness (buccal corridor) and smile attractiveness was shown in this study (Table 1 Graph 1). The broader the smile (the smaller the buccal corridor), the more attractive the panel judged the smile to be. Similarly, the narrower the smile (the larger the buccal corridor), the less attractive the smile. On average, broad smile fullness was rated the best, followed by medium-broad fullness, medium fullness, and medium-narrow smile fullness. Narrow smile fullness was rated least attractive.

Table 1 Comparison of distribution of mean scores between the 5 smile fullnesses (2%, 10%, 15%, 22%, 28%).

N=30	Mean	SD	p-value	Bonferroni test
score2	11.95	3.29		
score10	10.76	1.95		
score15	8.06	1.63	<0.001	2>10>15>22>28
score22	5.41	1.65		
score28	3.81	2.10		

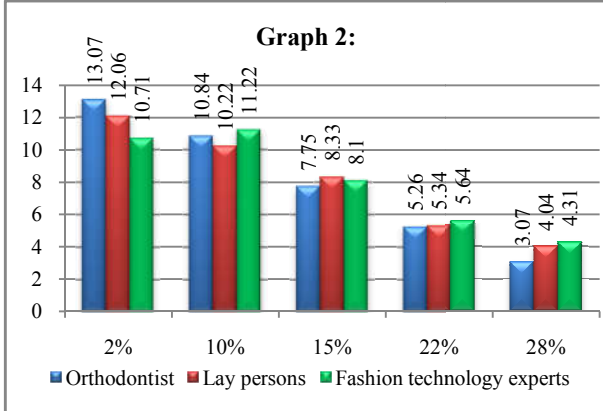


Graph 1 Bar diagram showing comparison of mean scores for five smile fullnesses given by all the judges

ANOVA with post hoc tukey’s test to compare the distribution of mean scores between the 3 groups of judges showed significant differences between the scores given by the three different judges (Table 2 and Graph 2).

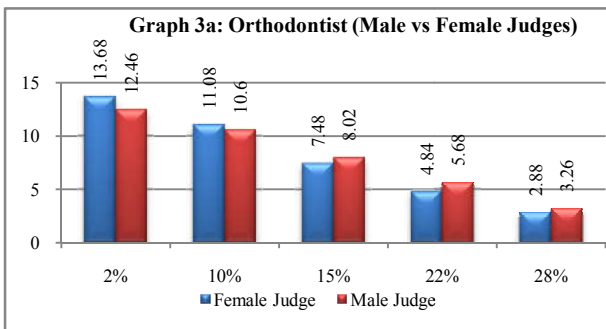
Table 2 Comparison of distribution of mean scores between the 3 groups of judges (Orthodontists, Lay persons and Fashion technology experts).

	Judge group						p-value	Post-hoc test
	Orthodontist [1] (n = 10)		Lay persons [2] (n = 10)		FT experts [3] (n = 10)			
	Mean	SD	Mean	SD	Mean	SD		
score2	13.07	2.06	12.06	2.84	10.71	4.20	<0.001	1,2>3
score10	10.84	1.44	10.22	1.83	11.22	2.36	0.001	3>2
score15	7.75	1.15	8.33	1.93	8.10	1.68	0.04	2>1
score22	5.26	1.40	5.34	1.74	5.64	1.78	0.231	-
score28	3.07	1.51	4.04	1.97	4.31	2.51	<0.001	1<2,3

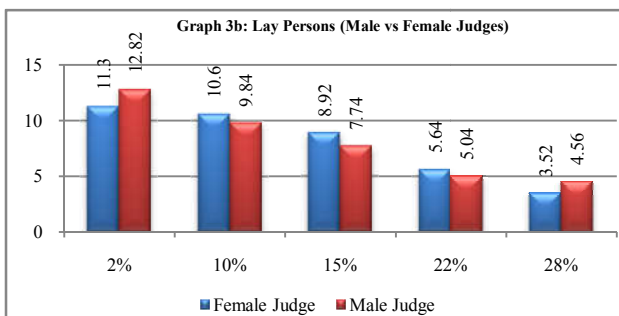


Graph 2 Bar diagram showing distribution of mean scores between the 3 groups of judges (Orthodontists, Lay persons and Fashion technology experts).

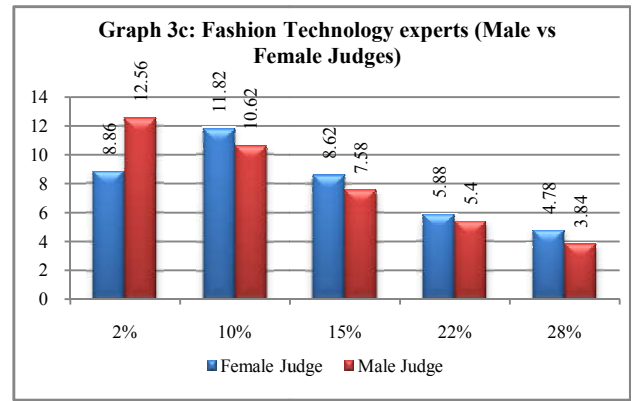
Significant differences were noted between the scores given by different groups of judges for broad smile fullness, medium-broad fullness, medium fullness, Narrow smile fullness. Independent sample t test to compare the distribution of mean scores between the male and female judges showed significant differences (Graphs 3a to 3c).



Graph 3a Bar diagram showing distribution of mean scores between the male and female Orthodontists



Graph 3b Bar diagram showing distribution of mean scores between the male and female Lay persons



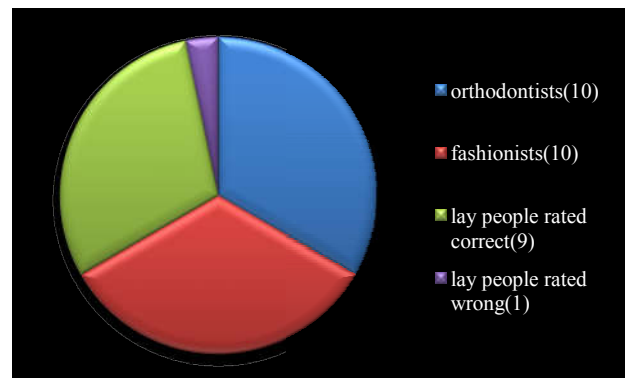
Graph 3c Bar diagram showing distribution of mean scores between the male and female Fashion technology experts.

There was statistically significant differences between mean scores given by male and female Orthodontists for broad smile fullness, medium fullness, medium-narrow smile fullness, male and female lay persons for broad smile fullness, medium-broad fullness, medium fullness, Narrow smile fullness and male and female fashion technology experts for broad smile fullness, medium-broad fullness and medium fullness.

Independent sample t test to compare the distribution of mean scores between the male and female subjects showed significant difference (Table 4).

Table 4 Comparison of distribution of mean scores between the male and female subjects

	Subject Gender	Subject Gender				p-value
		Females (n=05)		Males (n=05)		
		Mean	SD	Mean	SD	
Orthodontist	score2	13.14	2.08	12.40	1.78	0.28
	score10	10.89	1.46	10.40	1.17	0.311
	score15	7.73	1.14	7.90	1.29	0.666
	score22	5.21	1.43	5.70	1.16	0.299
	score28	3.03	1.47	3.40	1.90	0.47
Lay persons	score2	11.99	2.81	12.70	3.13	0.455
	score10	10.16	1.80	10.80	2.15	0.294
	score15	8.27	1.71	8.90	3.41	0.576
	score22	5.41	1.77	4.70	1.34	0.221
	score28	4.17	1.96	2.90	1.79	0.054
FT experts	score2	11.17	3.74	6.60	5.93	0.039
	score10	10.91	2.19	14.00	2.05	<0.001
	score15	8.03	1.69	8.70	1.57	0.235
	score22	5.58	1.78	6.20	1.81	0.298
	score28	4.29	2.50	4.50	2.76	0.803



Graph 5 Pie diagram showing distribution of mean scores given by three groups of judges to identical pairing.

There was no statistically significant difference between mean scores of male and female subjects given by Orthodontists.

There was statistically significant differences between mean scores of male and female subjects given by lay persons for Narrow smile fullness and fashion technology experts for broad smile fullness, and medium-broad fullness.

As for the identical photograph pairings 98% subject's identical photographs were correctly marked. 29 of the 30 judges correctly identified the identical photographs.

DISCUSSION

Broad smile fullness was judged by lay people to be more attractive than narrow smile fullness. That is, Smiles with large buccal corridors are considered less attractive.

The findings of the present study parallel a trend noted by Dunn, (Dunn WJ *et al*, 1996)⁵, (J.Parekh *et al*, 2006)⁶, (Adam J. Martin *et al*, 2007)⁷. Two recent studies examined the effect of buccal corridor on smile esthetics using digital manipulation. Roden-Johnson *et al* (Roden-Johnson *et al*, 2005)⁸ found no difference in female smiles with and without buccal corridors when judged by Orthodontists, General dentists and Laypersons. This contrasts the results of this study. Roden-Johnson *et al* did not quantify buccal corridors. They were classified as present or absent. It is possible that their buccal corridors did not meet the threshold for excessive buccal corridors determined by this study.

The findings of this study contrast sharply with those of Hulsey (Hulsey CM *et al*, 1970)⁹ who reported that lay people had no preference regarding buccal corridor width and that width variations seemed to be of no significance in determining smile attractiveness. Hulsey calculated the intercanine width/smile with ratio and did not take into account any visible dentition distal to the maxillary canines. Hulsey used pictures limited to mouths. We used pictures of the entire face and can conclude that the size of buccal corridors influences smile attractiveness when the entire face is taken in context.

This study also contradicts the findings by the Dustin Roden Johnson (Dustin Roden Johnson *et al*, 2005)¹⁰ study because he also considered buccal corridors from canine to canine and also only the perioral photographs were used rather than full-face frontal smiling photographs. Orthodontists, dentists, and laypeople evaluated smiles differently. Dentists and orthodontists group showed a preference to broader arch forms which itself indicates that broader smile fullness and small buccal corridors are more esthetic. Laypeople have no preference between treated or untreated arch forms.

The findings of the present study parallel a trend noted by Hideki Ioi (Hideki Ioi *et al*, 2009)¹¹. This study concludes that the amount of buccal corridors affected the assessment of smile esthetics. There was no significant difference in the estheticscores between the male and female raters which is in contrast to the present study.

The findings of the present study parallel a trend noted by Adam J. Martin (Adam J. Martin *et al*, 2007)¹². Orthodontists and laypeople prefer smiles with no or small buccal corridors over those with large buccal corridors. Laypeople were not as discriminating as orthodontists regarding buccal corridor size and smile attractiveness.

How do these results translate into clinical practice? In this study the subject's facial type was also considered. Facial

macro-esthetics is found to affect the influence of buccal corridors on general smile esthetics.

Finally, although this study establishes the importance of one esthetic feature in the art of orthodontics, its findings should not be interpreted as advocating indiscriminate maxillary arch expansion. Maxillary expansion, orthopedically or surgically achieved to correct a maxillary transverse deficiency might be a rational treatment option and the reduction of large buccal corridors in such a case will improve esthetics and should be a consideration in treatment planning. However, reduction of buccal corridors should not be considered the rationale for maxillary expansion in an otherwise normal maxilla.

Due consideration must be given to biologic limitations and esthetic goals must not be set purely on the basis of mathematical formulae. The conclusion of this study points to give consideration to the buccal corridors in the final esthetics, but within biological limits.

CONCLUSION

- When the only difference between altered images of a smiling subject was the broadness of smile, the presence of broad smile fullness was consistently judged by lay people and other panels to be more attractive than narrower smile fullness.
- Significant difference was found in judging smile attractiveness with varying levels of smile fullness between male and female judges.
- Significant difference was found in judging smile attractiveness with varying levels of smile fullness between male and female subjects. Female subject's smiles were rated more attractive than that of male subject's smile.
- Having minimal buccal corridors is preferred esthetic feature for both men and women, and large buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning.

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