

# Cephalometric Variables Influencing Soft Tissue Profile Beauty in Pakistani Population

Huma Saleem, Syed Shah Faisal, Syed Sheeraz Hussain

## ABSTRACT

**Objective:** To determine cephalometric factors influencing soft tissue profile beauty in Pakistanis and assess if the soft tissue values of Ricketts, Holdaway, and Merrifield analyses for Caucasians differ from those of attractive Pakistani profiles.

**Design:** Cross-sectional study

**Materials and Methods:** The study population included 45 subjects with normal occlusion and symmetric faces. Their lateral cephalograms were converted to black and white silhouettes, which were then ranked based on their attractiveness by a group of 30 laypeople. On the 12 profiles judged as aesthetically pleasing, Ricketts, Holdaway, and Merrifield analyses were performed. The Caucasian orthodontic norms were compared with the attractive group using a 1-sample t-test, taking a p-value of  $\leq 0.05$  as significant.

**Results:** The attractive group had significantly greater H angle ( $P = 0.001$ ), skeletal profile convexity ( $P = 0.002$ ), and superior sulcus depth ( $P = 0.041$ ), while nose prominence ( $P = 0.000$ ), Z angle ( $P = 0.000$ ), and total chin thickness ( $P = 0.002$ ) were less than the Caucasian norms.

**Conclusions:** This study showed a preference for Ricketts' lip projection values in Pakistanis. Additionally, the study population showed significant differences from the orthodontic norms proposed in Holdaway's and Merrifield's analyses.

## KEY WORDS

cephalometric analysis, facial silhouettes, esthetic perceptions, profile attractiveness, soft tissue profile

## INTRODUCTION

Beauty standards vary between demographic groups because of cultural, educational, ethnic, socioeconomic, and geographical differences<sup>1-3</sup>. Consequently, the aesthetic ideals of a specific group cannot appeal to other people<sup>4</sup>; hence, a need to study variations in the beauty standards of different population samples exists.

Several studies have established that typical Caucasian values should be carefully considered for patients of Pakistani origin<sup>4-6</sup>. Previously, norms have been defined for soft tissue variables of Pakistani faces, but these were not assessed in individuals perceived as attractive by the general public<sup>5,7-8</sup>.

One of the primary reasons for seeking orthodontic treatment is to enhance facial beauty. Therefore, it is imperative to determine the beauty standard of the public for soft tissue profiles so that treatment by orthodontists is provided accordingly<sup>1,2</sup>.

The objective of this study was to evaluate elements that contribute to the attractiveness of the soft tissue profile of Pakistanis and assess if the values proposed by Ricketts, Holdaway, and Merrifield for Caucasians differed from those of the attractive faces of the Pakistani population. In reviewing the literature, a lack of research work investigating the perception of soft tissue profile attractiveness in Pakistan was recognized.

## MATERIALS AND METHODS

The Ethical and Scientific Review Committee of Karachi Medical and Dental College approved this cross-sectional study. Pre-treatment lateral cephalograms of 45 patients at the Department of Orthodontics, Karachi Medical and Dental College, were used for data collection after informed consent from the subjects. Patients who met the inclusion criteria were selected. This comprised Pakistanis of both genders with permanent dentition, symmetrical frontal face, class I molars, and canine relationship exhibiting clear visibility of all required parameters on a lateral cephalometric radiograph. Exclusion criteria included patients with a history of orthodontic treatment, facial plastic surgery, or craniofacial deformities and syndromes. Soft tissue profile outlines were carefully traced manually from lateral cephalometric films on matte acetate sheets. The profiles were scanned and converted into soft tissue silhouettes against a white background (Adobe Photoshop CC 2020). A panel of 30 Pakistani laypersons (15 males and 15 females) of varying ages and professions observed and scored the profile outlines of the subjects. The occupations of these laypeople were not related to facial beauty (e.g., beautician, plastic surgeon, etc.).

Each silhouette was rated according to the following:

5 points	4 points	3 points	2 points	1 point
Very pleasant	Pleasant	Average	Unpleasant	Very unpleasant

Ratings were assigned to each silhouette by each judging layperson. The average score of each silhouette was calculated, and profiles with

Received on July 20, 2022 and accepted on August 5, 2022  
Department of Orthodontics, Karachi Medical and Dental College  
W3V6+27P, Block M North Nazimabad Town, Karachi, Karachi City, Sindh 74700, Pakistan

Correspondence to: Huma Saleem  
(e-mail: humaslm92@gmail.com)

ORCID ID:  
Huma Saleem: 0000-0003-1572-2228  
Syed Shah Faisal: 0000-0001-7686-6511  
Syed Sheeraz Hussain: 0000-0002-7907-9422

**Table 1: Details of layperson judges**

Age (in years)	Gender	Occupation
60	Female	Homemaker
25	Male	Software developer
30	Female	Accountant
22	Male	Office clerk
25	Female	MBA student
22	Female	Teacher
22	Male	Web designer
45	Female	Homemaker
23	Male	Software developer
27	Male	Software engineer
23	Male	Software engineer
29	Male	MBA student
26	Female	MBA student
28	Female	Accountant
28	Female	Psychologist
18	Female	Engineering student
23	Male	Freelancer on online shopping site
40	Female	Teacher
17	Male	College student
29	Male	Software engineer
24	Male	Software engineer
21	Male	Sales executive
30	Male	English literature university student
20	Male	Mass communications university student
21	Male	Computational math university student
29	Female	Homemaker
31	Female	Accountant
31	Female	Administrative associate
27	Female	Engineer
29	Female	Homemaker

an average score of more than 3 were selected as pleasant or attractive. This attractive group constituted 12 subjects.

Lateral cephalograms of our pleasant profile group were re-traced manually on the same acetate paper sheets over an illuminator. The mid-lines of double contour bilateral structures were drawn to minimise the error caused by head positioning. The Ricketts, Holdaway, and Merrifield soft tissue analyses were carried out to measure 16 angular and linear measurements based on the identified landmarks.

The values of each measurement were recorded on the pro forma with the baseline data, together with age and sex. IBM SPSS version 25 was used for data entry and analysis. Averages of each cephalometric value of the visually attractive group (scores > 3) were compared with Caucasian orthodontic norms as defined by Holdaway, Ricketts, and Merrifield with the use of a 1-sample t-test. The level of significance was set at 0.05.

## RESULTS

Pre-treatment lateral cephalometric radiographs were taken from 45 subjects with a mean age of  $19.4 \pm 4.7$  years (range 13–34 years), including 46.66% (N = 21) males with a mean age of  $19.4 \pm 4.8$  years and 53.33% (N = 24) females with a mean age of  $19.6 \pm 4.5$  years. 30 laypeople (15 males and 15 females) judged the profile outlines of the subjects (Table 1, Chart 1). The mean age of profile scorers was  $27.5 \pm 8.4$  years. The mean age of male scorers was  $23.7 \pm 3.6$  years and that of female scorers was  $31.2 \pm 10.2$  years.

**Table 2: Age and sex of attractive profile group**

Age (in years)	Gender
31	Male
34	Female
16	Female
23	Female
13	Female
21	Female
22	Female
22	Female
19	Female
16	Male
20	Female
14	Female

The mean score of profile attractiveness was  $2.7 \pm 1.2$ . The average profile attractiveness score in men was  $2.7 \pm 1.2$  and in women, it was  $2.8 \pm 1.2$ . The attractive profile group (those with an average score above 3) included 12 subjects with a mean age of  $20.9 \pm 6.3$  years (Table 2). The attractive group comprised 10 females and 2 males (Figure 1). The independent-sample t-test revealed a significant difference in the sexes' profile attractiveness scores (P = .006).

The cephalometric measurements of aesthetically pleasing profiles were compared with conventional Caucasian values (Table 3). The H angle (P = 0.001), skeletal profile convexity (P = 0.002), and superior sulcus depth (P = 0.041) were found to be significantly larger in our sample.

Nose prominence (P = 0.000), Z angle (P = 0.000) and total chin thickness (P = 0.002) were significantly smaller in the attractive group compared to the Caucasian norms.

In the pleasant profiles, the following measurements were not statistically different from Caucasians: upper lip to E-plane; lower lip to E-plane; soft tissue facial angle; sub-nasale to H-line; basic upper lip thickness; upper lip strain; lower lip to H-line; inferior sulcus to H-line; soft tissue chin thickness; and upper lip thickness.

## DISCUSSION

We attempted to evaluate the cephalometric factors influencing soft tissue profile attractiveness in our Pakistani population sample. Furthermore, through this study, we seek to detect whether there are differences between our attractive profile group and the Caucasian standards established by Ricketts, Holdaway, and Merrifield.

The orthodontic values recommended for the white population of North American or European descent are based on orthodontic features<sup>9-11</sup>, not necessarily deemed aesthetic by the general public. Moreover, despite inter-ethnic variation in profile preferences, these norms are routinely applied to patients of other races. It has been noted that African Americans prefer straighter profiles with variations in lip fullness<sup>12</sup>, while Japanese and Hispanic Americans, in comparison to African Americans, prefer less convex profiles<sup>3</sup>. To address the aesthetic demands of a particular ethnicity, it is vital to direct orthodontic treatment towards the beauty standard of that demographic group.

To minimise unnecessary X-ray exposure, subjects were recruited who had already presented with pre-treatment lateral cephalograms as part of their orthodontic treatment. By using radiographic outlines instead of photographic profiles, biases arising from the complexion, makeup, features of eyes and hair, gender, and age of subjects were avoided. Moreover, inaccuracies associated with the positioning of the head were also eliminated.

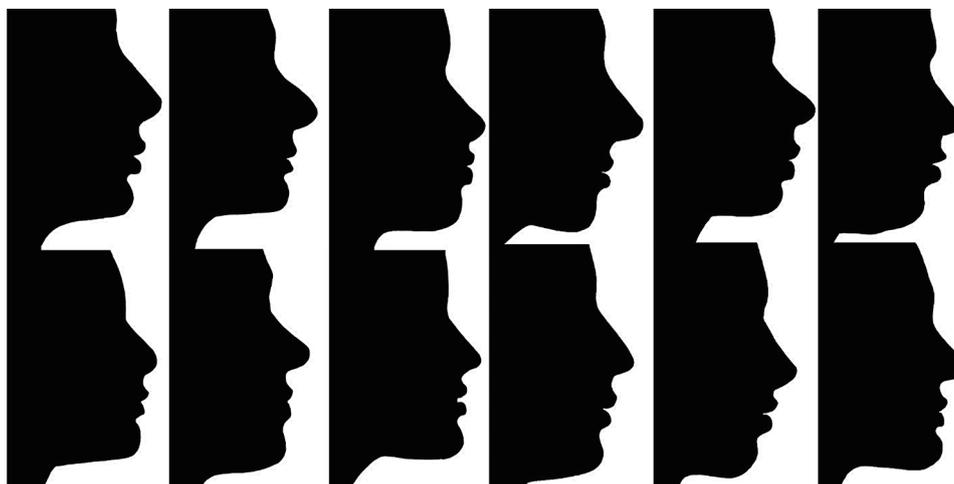
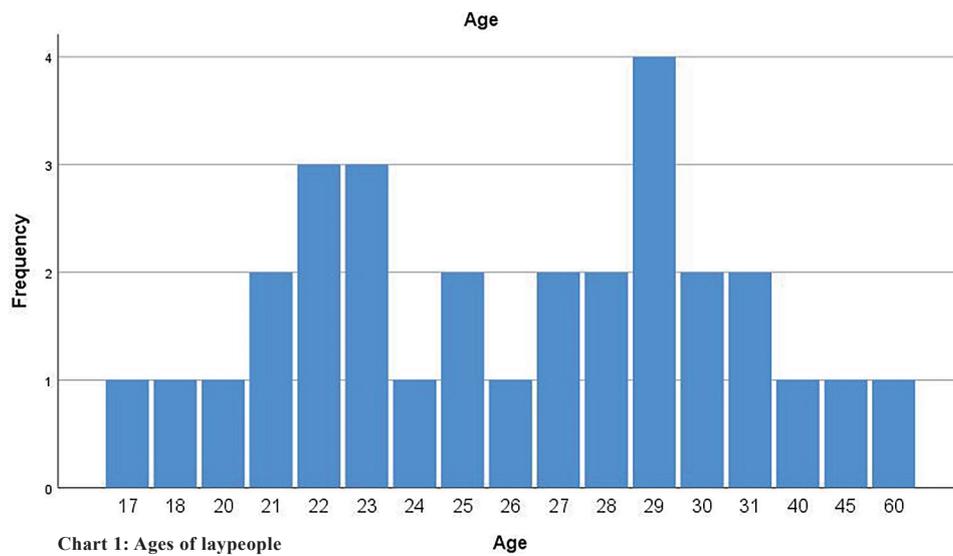
Earlier, researchers used profile images of one or two subjects morphed by computer software for the assessment of soft tissue beauty<sup>1,12</sup>. We, however, selected multiple patients with differing facial profiles to avoid the use of computer-generated images that may not mimic natural soft tissue contours. The age range of our sample was between 13 and 34 years old, which was much larger than the previous studies<sup>1,3</sup>.

We designed our research to evaluate the preference for soft tissue

**Table 3: Comparison of soft tissue Caucasian norms proposed by Ricketts, Holdaway, and Z-Merrifield with the visually attractive Pakistani profile sample, using 1-sample t test**

Parameters	Units	Mean	Std. Deviation	95% CI		Maximum	Minimum	Mean Orthodontic Norm	P value
				Lower	Upper				
				Attractive profiles (n = 12)					
Upper lip - E plane	mm	-3.7	2.38	-1.22	1.8	0	-7	-4	0.68
Lower lip – E plane	mm	-1.37	2.11	-0.71	1.96	2.5	-4	-2	0.327
Soft tissue facial angle	°	90.75	4.61	-0.25	-3.18	102	83	91	0.855
Nose prominence	mm	12.95	3.42	-8.21	-3.86	20	8	19	0.000*
Superior sulcus depth	mm	3.54	0.81	0.02	1.05	5	2.5	3	0.041*
Sub-nasale to H line	mm	6.2	1.93	-0.021	2.43	10	3	5	0.054
Skeletal profile convexity	mm	2.2	1.85	1.03	3.38	6	0	0	0.002*
Basic upper lip thickness	mm	14.29	2.56	-2.33	0.91	19	10	15	0.359
Upper lip strain	mm	11.29	1.86	-8.92	1.47	15	9	11	0.599
H angle	°	16	3.69	2.65	7.34	21	10	11	0.001*
Lower lip to H line	mm	-0.12	1.33	-1.47	0.23	2	-3	0.5	0.133
Inferior sulcus to H line	mm	5.79	1.37	-0.08	1.66	8	4	5	0.071
Soft tissue chin thickness	mm	11.33	2.39	-1.18	1.85	15	7	11	0.639
Total chin thickness	mm	13.37	2.19	-4.02	-1.22	18	10	16	0.002*
Upper lip thickness	mm	13.66	3.34	-2.45	-1.79	19	10	14	0.737
Z angle	°	72.41	4.64	-10.53	-4.63	80	65	80	0.000*

\*P ≤ 0.05

**Figure 1: Soft tissue profile silhouettes of the attractive group (n = 12)**

profiles from the point of view of the general public. The panel of lay-people who scored included those with professions unrelated to facial beauty to counter professional opinions affecting their judgments.

The silhouettes of a normal, balanced facial profile are the most preferred among the public and dental professionals, irrespective of ethnicity. However, a significant disparity between the preferences for the two genders has been found in previous studies<sup>12-14</sup>. Polk *et al.* found that African Americans prefer more protrusive profiles for males in comparison to females<sup>12</sup>. On the contrary, Turks and Germans find flat profiles for males and convex profiles for females more attractive<sup>13,14</sup>. In our study, a significant difference between the profile attractiveness scores of the sexes was found, which contrasts with the findings of previous research on the Persians<sup>1</sup>. Most of our attractive group (83.33%) consisted of female subjects. However, we did not assess gender dimorphism in facial aesthetics.

In prior publications, significant variations have been found from the Caucasian norms in the aesthetically pleasing profiles of different races. Greater values of the H angle and skeletal profile convexity were noticed in our attractive sample, both of which suggest a more convex profile. This finding was also similar among Persians, Chinese, and Yemenis<sup>3,15-16</sup>. In Turks, the H angle was preferred larger than the Holdaway norm, as is the skeletal profile convexity in African Americans<sup>17,18</sup>.

The superior sulcus depth used to quantify the upper lip curl was significantly larger in the attractive profiles of our study in comparison to the orthodontic norms, indicating that Pakistanis prefer a more prominent, fuller upper lip. This was consistent with the preferences of the Chinese and Persians<sup>3,15</sup>.

Iranians, Chinese, and Pakistanis are desired with less prominent noses, compared to Turkish males, for whom prominent noses are preferred<sup>3,14,15</sup>. Isiekwe *et al.* found that the least prominent noses were found in Nigerians and Chinese, while the most prominent were those of Caucasians, Pakistanis, Palestinians, and Turks<sup>19</sup>.

Total chin thickness, which Merrifield considered of prime importance for a balanced profile<sup>11</sup>, was observed to be significantly smaller in our study sample compared to the Caucasian ideals. This is in disagreement with the findings in Turkish and Italian males, for whom prominent chins have been favoured<sup>14,20</sup>.

The Z angle was also less in our aesthetically pleasing group than the recommended values for the Caucasians. This was in line with the results for Persians and Turks<sup>3,18</sup> and in contrast to the preference of African Americans, who were inclined towards profiles with larger Z angles<sup>17</sup>.

Out of the 16 parameters examined in our research, 10 were not statistically different from Caucasian orthodontic values. Pakistanis, in addition to Yemenis, favour the lips projection values of Ricketts<sup>16</sup>. However, upper lips are favoured more recumbent than Caucasian norms in Persians and Turks<sup>3,18</sup>. The results of our study for the lower lip to E plane matched those of Persian ancestry<sup>3</sup>, but were dissimilar to the findings of another Pakistani population sample<sup>6</sup>. This contradiction is likely due to differences in assessment methodology.

Our results were similar to the findings in Persians for soft tissue facial angle, sub nasale and lower lip to H line, upper lip thickness, and strain, and basic upper lip thickness. All of these were in agreement with the Caucasian standards<sup>3</sup>. According to Lew *et al.*, the sub nasale to H line was larger in Chinese attractive faces, in contrast to the findings in Pakistanis and Persians<sup>3,4,16</sup>. Basic upper lip thickness and upper lip thickness values were also found to be larger in aesthetically pleasing Yemeni profiles, dissimilar to our results in Pakistanis and those of Ghorbanyjavdour and Rakhshan in Persians<sup>3,17</sup>. For the lower lip to the H line, Pakistanis, as well as Persians and Turks, prefer Caucasian norms<sup>3,19</sup>.

Inferior sulcus to H line and soft tissue chin thickness were also not found statistically different in the present study from Caucasians, contrary to findings in Chinese and Persians. Persians prefer greater and Chinese people favour lesser values of these two measurements<sup>3,16</sup>.

The norms proposed by Ricketts for lip projection are preferable to the Pakistani public. However, values by Holdaway and Merrifield must be further investigated to determine their role in the beauty of the soft tissue profile of Pakistanis.

Different elements of cephalometric geometries work in unison to amplify or compensate for the disproportion between the aesthetic units to produce an attractive facial profile. A single aesthetic component, dis-counting all others, should not be considered the sole contributor to pro-

file beauty. Due to the multifaceted and interconnected variables of the soft tissue, more evidence is necessary for the result's verification.

## CONCLUSION

- The values established by Ricketts for lip projection are favoured in Pakistani profiles.
- Pakistani aesthetically pleasing profiles show a significant difference in soft tissue cephalometric variables from Caucasian orthodontic norms proposed by Holdaway and Merrifield.

## CONFLICT OF INTEREST

None

## REFERENCES

1. Khosravanifard B, Rakhshan V, Raeesi E. Factors influencing attractiveness of soft tissue profile. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2013; 115: 29-37.
2. Nomura M, Motegi E, Hatch JP, *et al.* Esthetic preferences of European American, Hispanic American, Japanese, and African judges for soft-tissue profiles. *Am J Orthod Dentofacial Orthop.* 2009; 135: S87-S95.
3. Ghorbanyjavdour F, Rakhshan V. Factors associated with the beauty of soft-tissue profile. *Am J Orthod Dentofacial Orthop.* 2019; 155: 832-43.
4. Zia B, Erum G, Ahmed I. Comparison of Pakistani and Caucasian cephalometric values according to Steiner's analysis. *Int J Dent Health Sci.* 2017; 4: 279-83.
5. Panezai S, Mengal N, Ahmed S. Determination of cephalometric soft tissue norms for local population with normal occlusion using Holdaway analysis. *PAFMJ.* 2021; 71: 557-61
6. Khan B, Bashir U, Durrani OK, Ahmed I. Can we use Caucasians norms on Pakistani population? *POJ.* 2018; 10: 14-8.
7. Shafi AM, Khan FN, Khan AG, Nadeem M, Khurshed T, Jehan S, Qamaruddin I, Alam MK. A soft tissue cephalometric analysis for Pakistani adult using Holdaway's analysis. *Int. Medical J.* 2018; 25: 51-63.
8. Mahmood HT, Badar SB, Ahmed I, Uzair M. Soft tissue profile analysis by means of linear and angular parameters in Pakistani population. *J Dow Univ Health Sci.* 2019; 13: 55-61.
9. Ricketts RM. Planning treatment on the basis of the facial pattern and an estimate of its growth. *Angle Orthod.* 1957; 27: 14-37.
10. Holdaway RA. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. *Am J Orthod* 1983; 84: 1-28.
11. Merrifield LL. The profile line as an aid in critically evaluating facial esthetics. *Am J Orthod.* 1966; 52: 804-22.
12. Polk MS Jr, Farman AG, Yancey JA, Gholston LR, Johnson BE, Regennitter FJ. Soft tissue profile: a survey of African-American preference [published correction appears in *Am J Orthod Dentofacial Orthop* 1995; 108: 566]. *Am J Orthod Dentofacial Orthop.* 1995; 108: 90-101.
13. Matoula S, Pancherz H. Skeletofacial morphology of attractive and nonattractive faces. *Angle Orthod.* 2006; 76: 204-10.
14. Türkkahraman H, Gökalp H. Facial profile preferences among various layers of Turkish population. *Angle Orthod.* 2004; 74: 640-7.
15. Lew KK, Ho KK, Keng SB, Ho KH. Soft-tissue cephalometric norms in Chinese adults with esthetic facial profiles. *J Oral Maxillofac Surg.* 1992; 50: 1184-90.
16. Al-Gunaid T, Yamada K, Yamaki M, Saito I. Soft-tissue cephalometric norms in Yemeni men. *Am J Orthod Dentofacial Orthop.* 2007; 132: 576. e7-14.
17. Hall D, Taylor RW, Jacobson A, Sadowsky PL, Bartolucci A. The perception of optimal profile in African Americans versus white Americans as assessed by orthodontists and the lay public. *Am J Orthod Dentofacial Orthop.* 2000; 118: 514-25.
18. Erbay EF, Caniklioğlu CM, Erbay SK. Soft tissue profile in Anatolian Turkish adults: Part I. Evaluation of horizontal lip position using different soft tissue analyses. *Am J Orthod Dentofacial Orthop.* 2002; 121: 57-64.
19. Isiekwe G I, daCosta OO, Utomi IL, Sanu OO. Holdaway's analysis of the nose prominence of an adult Nigerian population. *Niger J Clin Pract.* 2015; 18: 548-52.
20. Sforza C, Laino A, D'Alessio R, Grandi G, Tartaglia GM, Ferrario VF. Soft-tissue facial characteristics of attractive and normal adolescent boys and girls. *Angle Orthod.* 2008; 78: 799-807.