

# Cephalometric determination of nasal profile in patients presenting at a tertiary care hospital

Asim Riaz<sup>a</sup>, Usman Zaheer<sup>b</sup>, Nauman Zaheer<sup>c</sup>, Naseer Ahmed Chaudhry<sup>d</sup>,  
Muhammad Imran Rahbar<sup>e</sup>, Maliha Nauman<sup>f</sup>

## Abstract

**Introduction:** In modern orthodontics, the goals and objectives of treatment planning have evolved from hard to soft tissue paradigm. However, the attractiveness of facial and aesthetic features may vary among different ethnic groups. Many orthodontists carried out different cephalometric analyses to find out nasal profile along with its relation to facial profile. The mean values formulated by different authors may not be proper to serve as references for other racial groups. Therefore, each population should be treated according to specific characteristics of its own. The objective of this study was to determine mean cephalometric values and angles for nasal profile in Pakistani adults.

**Material and Methods:** 85 subjects including students of Fatima Memorial college of dentistry and out-patient department of Fatima Memorial Hospital were selected. Collected data was entered and analyzed in computer program SPSS version 20. Stratification was done with regard to age and gender to control confounders and “t” test was applied. P-value of 0.05 or less was considered as statistically significant.

**Results:** Results of the study show that there is no significant sexual dimorphism in nasal profile within Pakistani population. Nasal tip projection and nasolabial angle of Pakistani population is less obtuse whereas columellar rotation, nasofrontal angle and bony nasal angle are more obtuse than Caucasian norms.

**Conclusions:** Gender specific mean values for nasal profile can be applied in planning and treating orthodontic cases for Pakistani population.

**Keywords:** Soft tissue facial profile; nose position; lateral cephalogram

## Introduction

The word Orthodontics is derived from Greek word ‘orthos’, which means normal or correct and ‘dontos’ which stands for teeth.<sup>1</sup> There is high prevalence of malocclusion and the treatment results are not ideal which can affect the quality of life of an individual and affect appearance and

function.<sup>2</sup> Orthodontists all over the world are keen to take a look at the skeletal and soft tissue condition of the patient along with position of teeth while diagnosing and making a comprehensive plan for their cases.<sup>3</sup> Harmony among different parts of the face is important and nasal profile plays a vital role due to its location in middle of the face. Shape and form of the nose greatly influences the attitude and perception towards facial appearance.<sup>4</sup> In past, many methods have been used to evaluate and examine nasal profile including photographic analysis, morphometry stereophotogrammetry and radiography.<sup>4</sup>

Cephalometric radiography is a better tool to aid in diagnosis and treatment planning of orthodontic cases as it provides imaging of the soft and hard tissues of the face.<sup>4,5</sup> There are many uses of cephalometry in

<sup>a</sup> Corresponding Author; BDS, FCPS; Assistant Professor, Orthodontics. Fatima Memorial College of Dentistry, Lahore. Email: dr\_asim@live.com

<sup>b</sup> BDS, FCPS; Assistant Professor, Orthodontics, Lahore Medical and Dental College, Lahore.

<sup>c</sup> BDS, Mphil; Assistant Professor, Oral Biology, CMH Lahore Medical College, Institute of Dentistry. National University of Medical Sciences.

<sup>d</sup> BDS, FCPS, MCPS, MCPS-HPE, MPH; Professor, Orthodontics. Fatima Memorial College of Dentistry, Lahore.

<sup>e</sup> BDS, FCPS; Professor, Orthodontics, Fatima Memorial College of Dentistry, Lahore

<sup>f</sup> BDS, Mphil; Assistant Professor, Oral Biology, Rashid Latif Medical College.

orthodontics which includes studying physical growth of an individual, analyzing treatment progress, position of teeth within the bone, predicting rate of growth and many others in orthodontic research.<sup>5</sup> Cephalometric radiography has been used greatly in orthodontics to develop the mean values for teeth, skeletal structures and soft tissue positions.<sup>5</sup>

Most of the patients going for orthodontic treatment have specific expectations in the outcome of treatment which requires careful evaluation of soft tissue position i.e. nose in relation to facial soft tissue and skeletal bases. For this reason, modern orthodontic treatment planning has shifted to the soft tissue paradigm.<sup>6</sup> Orthodontists have focused on different soft tissue measurements and facial aesthetics to fulfill expectations of patients regarding the outcome of treatment.<sup>6</sup> Many orthodontists have adapted various cephalometric analysis to find out nasal profile along with their relation to facial profile.<sup>7-8</sup> Stark and Epkar used different reference lines and measurements for an ideal and well balanced nasal profile.<sup>7-8</sup>

The cephalometric mean values devised for various populations are specific to an ethnic group that should be applied on the same groups as one normal measurement may look attractive in one population but may not look so in another.<sup>7</sup> Therefore each population should be treated according to specific characteristics of its own.<sup>7</sup> Literature reports varying results in determination of nasal profile in different racial groups when comparing with mean values of Caucasian samples of European-American ancestry.<sup>7-8</sup> There is significant difference among different ethnic groups when these cephalometric measurements are taken into consideration in orthodontics diagnosing and planning.<sup>7-10</sup>

Therefore, the aim of this study was to evaluate mean values and angles for nasal profile in Pakistani adult population helping

to diagnose and planning of orthodontic cases with more esthetic and stable results.

## Material and Methods

This cross-sectional study was carried out at the Orthodontics Department, Fatima Memorial Hospital, College of Medicine and Dentistry, Lahore. The duration of study was six months and sample size was estimated as 85 cases using 95% confidence level,  $d = 0.35$  with an expected mean  $\pm$  SD of nasal prominence i.e.  $4.00 \pm 0.00$  linear measurement in nasal profile. Lateral cephalograms of all participants were taken in natural head position. Institutional Review Board of FMH College of Medicine & Dentistry approved the study. Informed consent was taken once the sample was selected and their demographic profile were recorded. The primary outcome variables was nasal profile. Non-probability consecutive sampling technique was used. Inclusion criteria was age 15 to 40 years, class I occlusion with minor or no crowding on clinical assessment, symmetrical face on clinical evaluation, normal overjet and overbite, Competent lips and inter-labial gap of 0-4mm. Exclusion criteria was standardized as significant medical history that could affect growth e.g. Growth hormone deficiency etc., previous orthodontic or prosthodontic treatment and craniofacial deformities or trauma. Cephalograms were drawn manually. Cephalometric variables were recorded on a specifically designed proforma. Outcome variable in terms of nasal profile was noted as per operational definition. Participants who exhibited differences in nasal profile were made aware about their soft tissue facial profile.

Collected data was analyzed on SPSS version 21. Quantitative variables like age, nose prominence, total nasal height, upper nasal height, lower nasal height, nasal tip projection, radix projection, naso labial angle, columellar length, naso frontal angle and bony nasal angle were presented in the form

of mean and standard deviation. Qualitative data like gender were presented in the form of frequency and percentages. Stratification was done with regard to age and gender to control confounders and "t" test was applied. P-value of 0.05 or less was considered as statistically significant.

## Results

A total of 85 skeletal Class I cases were included in this study. The mean age of the patients was noted as  $21.53 \pm 1.93$  years with minimum and maximum ages of 17 & 30 years respectively (Table I). Out of a sample of 85, 46 (54%) were females and 39 (46%) were males (Figure 1).

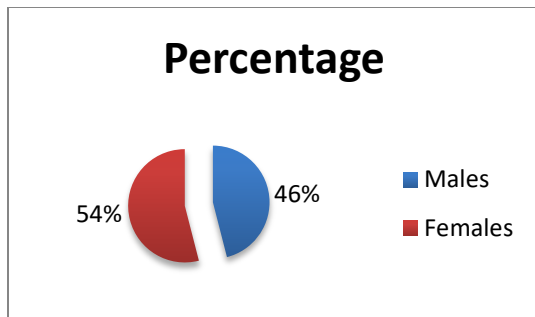
When linear parameters of nasal profile were measured, the results of the study indicated that the mean value of nasal prominence of the patients was  $3.47 \pm 2.27$  mm with minimum and maximum value of 0 and 12 mm respectively. The mean value of total nasal height of the patients was  $51.72 \pm 4.18$  mm with minimum and maximum value of 41 and 60 mm respectively. The mean value of upper nasal height of the patients was  $40.53 \pm 4.45$  mm with minimum and maximum value of 32 and 50 mm respectively. The mean value of lower nasal height of the patients was  $11.22 \pm 2.28$  mm with minimum and maximum value of 7 and 17 mm respectively. The nasal tip projection of the patients was  $27.87 \pm 4.45$  mm with minimum and maximum value of 20 and 40 mm respectively. The mean value of radix projection of the patients was  $4.59 \pm 1.04$  mm with minimum and maximum value of 3 and 7 mm respectively (Table II).

When angular parameters for nasal profile were measured, the results of the study indicated that the mean value of nasolabial angle of the patients was  $97.71 \pm 7.67$  degrees with minimum and maximum value of 75 and 115 degrees respectively. The mean value of columellar rotation of the patients was  $71.87 \pm 9.81$  degrees with minimum and maximum value of 59 and 91 degrees

respectively. The mean value of nasofrontal angle of the patients was  $125.24 \pm 9.27$  degrees with minimum and maximum value of 102 and 141 degrees respectively. The mean value of bony nasal angle of the patients was  $36.32 \pm 5.35$  degrees with minimum and maximum value of 23 and 48 degrees respectively (Table III).

The findings from the present study show that soft tissue values for nose did not vary with gender like nasal prominence, total nasal height, upper nasal height, lower nasal height, nasal tip projection, radix projection, nasolabial angle, columellar rotation, nasofrontal angle and bony nasal angle (Table IV).

When findings of this study were compared with Caucasian population, it was noted that five of the ten nose parameters studied showed significant difference. These parameters include nasal tip projection, nasolabial angle, columellar rotation, nasofrontal angle and bony nasal angle. The mean values of these findings in this study were  $27.87 \pm 4.45$ ,  $97.71 \pm 7.67$ ,  $71.87 \pm 9.81$ ,  $125.25 \pm 9.27$  and  $36.32 \pm 5.35$  respectively whereas norms for Caucasians are  $37.30 \pm 2.10$ ,  $111.9 \pm 11.70$ ,  $64.4 \pm 7.50$ ,  $118.6 \pm 7.90$  and  $31.4 \pm 2.00$  respectively. These findings indicate that nasal tip projection and nasolabial angle of Pakistani population is less than that of the Caucasian whereas columellar rotation, nasofrontal angle and bony nasal angle are obtuse than Caucasian norms. The nasal parameters, which showed no significant difference between the two ethnic groups, were nasal prominence, total nasal height, upper nasal height, lower nasal height and radix projection (Table V).



**Figure 1: Frequency distribution of Gender of patients**

**Table I: Frequency and percentage of different ages of total subjects**

		Frequency	Percent
Age	≤20	19	22.4
	21 - 25	44	51.8
	≥25	22	25.8
	Total	85	100.0

**Table II: Descriptive statistics of linear measurements in nasal profile**

Measurements	Mean	Standard Deviation	Maximum	Minimum
Nasal prominece	3.47	2.27	0	12
Total nasal height	51.72	4.18	41	60
Upper nasal height	40.53	4.45	32	50
Lower nasal height	11.22	2.28	7	17
Nasal tip projection	27.87	4.45	20	40
Radix projection	4.59	1.04	3	7

**Table III: Descriptive statistics of angular measurements in nasal profile**

Measurements	Mean	Standard Deviation	Maximum	Minimum
Naso labial angle	97.71	7.67	75	115
Columellar rotation	71.87	9.81	38	91
Naso frontal angle	125.24	9.27	102	141
Bony nasal angle	36.32	5.35	23	48

**Table IV: Descriptive statistics of nasal profile in males and females**

Measurements	Males		Females		t value	P-value	Confidence Interval	
	Mean	Standard Deviation	Mean	Standard Deviation			Lower	Upper
Nasal prominece	3.62	2.46	3.35	2.11	0.539	0.591	-0.720	1.255
Total nasal height	52.23	4.04	51.28	4.28	1.043	0.300	-0.860	2.757
Upper nasal height	40.54	4.09	40.52	4.85	0.017	0.986	-1.942	1.976
Lower nasal height	11.10	2.03	11.33	2.37	-0.461	0.646	-1.188	0.741
Nasal tip projection	28.08	4.61	27.70	4.35	0.391	0.697	-1.556	2.319
Radix projection	4.77	0.95	4.43	1.08	1.490	0.140	-0.112	0.781
Naso labial angle	98.90	6.84	96.70	8.20	1.329	0.188	-1.094	5.498
Columellar rotation	71.92	9.62	71.83	10.07	0.045	0.964	-4.176	4.369
Naso frontal angle	126.33	9.01	124.30	9.48	1.006	0.318	-1.984	6.042
Bony nasal angle	36.69	4.69	36.09	5.89	0.430	0.669	-1.825	2.830

**Table V: Descriptive statistics of comparison of Pakistani norms with established soft tissue norms for Caucasian population**

Measurements	Pakistani Norms		Caucasian Norms	
	Mean	Standard Deviation	Mean	Standard Deviation
Nasal prominece	3.47	2.27	4.00	0.00
Total nasal height	51.72	4.18	52.4	3.70
Upper nasal height	40.53	4.45	41.2	1.50
Lower nasal height	11.22	2.28	11.2	3.50
Nasal tip projection	27.87	4.45	37.30	2.10
Radix projection	4.59	1.04	6.50	1.40
Naso labial angle	97.71	7.67	111.9	11.70
Columellar rotation	71.87	9.81	64.4	7.50
Naso frontal angle	125.24	9.27	118.6	7.90
Bony nasal angle	36.32	5.35	31.4	2.00

## Discussion

Soft tissue cephalometric mean values are one of the most effective means in diagnosis and treatment planning of an orthodontic case and many orthodontists around the globe studied and developed these mean values for different ethnicities including Holdaway, Legan, Stark and Epkar soft tissue norms for Caucasian sample. These available mean values should not be applied to all races unless they are modified as one soft tissue norm may look pleasing in one ethnic group and may not be aesthetic in another.

These soft tissue values of nose are of utmost importance in planning orthognathic surgical cases or cases requiring rhino plastic procedures. Orthodontists and plastic surgeons use these values as standard to plan cases and predict end results of the surgery within the aesthetic limits. Measurements evaluated in this study were divided into linear and angular measurements. Sexual dimorphism was carried out for the same population and then results were compared with mean values available in literature for Caucasian population.

When findings of this study were compared with Caucasian population, it was noted that five of the ten nose parameters studied showed significant difference when compared with Caucasian norms. These parameters include nasal tip projection, nasolabial angle, columellar rotation, nasofrontal angle and bony nasal angle. The findings indicated that nasal tip projection and nasolabial angle of Pakistani population is less than that of the Caucasian whereas columellar rotation, nasofrontal angle and bony nasal angle are obtuse than Caucasian norms.

Pattanaik et al<sup>11</sup> established soft tissue facial profile mean values for coastal Andhra population using angular measurements and determined the difference between males and females. The results of the study demonstrated statistically significant gender difference in naso-frontal angle between

males  $130.64 \pm 6.27$  and females  $140.33 \pm 6.85$ . These results are not consistent with the results of this study, which shows males exhibiting naso-frontal angle of  $126.33 \pm 9.01$  and females with  $124.30 \pm 9.48$  degrees. The results of this study however agree with Pattanaik et al upon naso labial angle, which is in normal range for both males and females. The values for this study are  $98.90 \pm 6.84$  and  $96.70 \pm 8.20$  for males and females respectively whereas the mean angles of Pattanaik et al for males was  $98.56 \pm 5.6$  and that for females was  $99.69 \pm 7.00$ .

The results of this study differ in nose prominence with study of Albarakati et al<sup>12</sup> in 2012. There is also contradiction of the results in sexual difference as both males and females have insignificant difference in nose prominence in this study where as Albarakati found out that Saudi males had more prominent nose as compared to Saudi females.

In 2006, a study conducted by Scavone et al<sup>13</sup> for Japanese-Brazilian adults indicated that ethnic differences are present for soft tissue length of the nose when compared with white norms. The results of current study contradict with findings and demonstrate that no difference is present in norms of Pakistani population and white norms. Nasolabial angle however is more acute than males and females of white norms.

In 2008, Garandawa et al<sup>14</sup> found out that mean values for Nigerian nose closely resemble that of Caucasians and these results are in accordance with the results of this study. There is no significant difference in norms for nasal length, columella and nasal tip prominence in both the studies and sexual difference has no significant impact on the mean values of these variables.

Alcalde et al<sup>15</sup> in 2000 showed that Japanese adults possessed obtuse nasolabial angle than white adults when they compared mean values for soft tissue using Holdaway, Ricketts, Epkar and Legan analysis and then compared them with white norms. The

results clearly contradict with the results of this study which demonstrates less obtuse naso labial angle and more obtuse naso frontal angle. All the other parameters show no difference with white population mean values.

The sexual dimorphism in this study and differences with other populations infer that soft tissue cephalometric norms for both horizontal lip position and nasal profile should be used as baseline data only for this population. It is hoped that the results of this study will provide significant objective database helping in diagnosing and planning cases for improved post treatment and postoperative outcomes. However, these mean values should not be taken as template but more of a guide in planning and treating an orthodontic, orthognathic or plastic surgery case. Every patient should be planned and treated according to desires of the individual.

## Conclusions

This study established cephalometric nasal profile mean values for a Pakistani population presenting in a tertiary care hospital:

1. There is no significant sexual dimorphism in nasal profile within Pakistani population.
2. Nasal tip projection and nasolabial angle of Pakistani population is less obtuse whereas columellar rotation, nasofrontal angle and bony nasal angle are more obtuse than Caucasian norms reported by Stark and Epkar.

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