Journal of Craniomaxillofacial Research

Vol. 11, Issue. 4 Autumn 2024

Nasal Profile and Its Relationship with Sagittal Dentoskeletal Pattern and Age in Iranian Adults

Mahdis Jahanbakhsh [1], Alireza Ghaderi Namin [1], Zohreh Reyhani [2], Farzane Ahmadi [3], Azin Nourian [4*]

1. School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.
2. Department of Oral and Maxillofacial Radiology, School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.
3. Department of Biostatistics, School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.
4. Department of Orthodontics, School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.

ARTICLE INFO

Article Type:
Original Article

Received: 7 June 2024
Revised: 7 August 2024
Accepted: 9 September 2024

**Corresponding author:*
Azin Nourian

Department of Orthodontics, School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.

Tel: +98-24-33148100
Fax: +98-51-33471161
Email: azin.nourian@gmail.com

ABSTRACT

Introduction: The nose, centrally positioned and a prominent facial feature, plays a critical role in facial aesthetics. Clinicians must understand its morphology and relationship with adjacent structures for optimal aesthetic outcomes. This study aims to investigate nasal morphology in Iranian adults and its correlation with sagittal dentoskeletal patterns and age.

Materials and Methods: Five linear and six angular parameters were measured on the lateral cephalograms of 300 Iranian adults, acquired in 2022 from the records of a private radiology center in Zanjan city. One-way ANOVA and Spearman`s correlation coefficient were used to analyze the data.

Results: The mean values of nasal depth, Holdaway`s nose prominence, nasofacial angle, nasomental angle, nasolabial angle and LNLA were not equal in different sagittal dentoskeletal patterns. The mean nasal depth in Class III individuals was significantly higher than in Class II div. 1 individuals. The mean of Holdaway's nose prominence in Class II div. 2 subjects was significantly higher than in Class II div. 1 subjects. The mean nasofacial angle in Class II subjects was significantly higher than in Class I subjects and in Class I subjects was significantly higher than in Class III subjects. The mean nasomental angle in Class III subjects was significantly higher than in Class I subjects and in Class I subjects it was significantly higher than in Class II subjects. Furthermore, the mean nasolabial angle and LNLA were significantly higher in Class II Div. 2 subjects than in Class III subjects. Among measured parameters, only Nasal depth showed a weak positive correlation with age with a correlation coefficient of 0.145.

Conclusion: Nose morphology in the Iranian population has a significant relationship with the sagittal dentoskeletal pattern. The measured parameters, except for nasal depth, were not correlated with the age of the subjects.

Keywords: Age; Cephalometry; Dentoskeletal pattern; Face; Nose.

Please cite this Article as:
Jahanbakhsh M, Ghaderi Namin A, Reyhani Z, Ahmadi F, Nourian A. Nasal Profile and Its Relationship with Sagittal Dentoskeletal Pattern and Age in Iranian Adults. J Craniomaxillofac Res 2024; 11(4): 232-239. DOI: 10.18502/jcr.v11i4.18711

Introduction

Facial appearance is very important for life satisfaction and social interaction [1]. Currently, it has become very popular to use various medical interventions to create facial balance and correct proportions [2,3]. For example, according to the American Society of Plastic Surgeons, there were 346,384 facial cosmetic surgeries performed in the United States in 2022 [4]. In the past, it was believed that facial beauty could only be provided by the establishment of the golden ratio in the face, and a Caucasian face was considered the ideal face [5-7]. But today these concepts are being questioned. This is because as research on different societies expands, natural anthropometric differences between different ethnicities and races become increasingly apparent [8]. In addition, there is increasing emphasis on taking people's preferences and expectations into account when planning effective cosmetic treatments. These preferences and expectations are also heavily influenced by people's cultural, ethnic, and racial backgrounds [9].

The nose is located in the center of the face and forms the most prominent part of the face profile. Therefore, the harmony between the nose and other parts of the face is very important for creating a well-proportioned and beautiful face [10,11]. Studies have shown that nasal morphology may be related to dentoskeletal classification [12-14]. It is essential for clinicians to know the morphological characteristics of the nose and its relationship with adjacent structures to obtain better cosmetic treatment results. To date, few studies have been conducted on the relationship between nose profile and craniofacial structures, especially in Iranians, and the main focus of studies has been on dentofacial patterns [15-18]. The purpose of this study was to investigate the morphology of the nose in a sample of Iranian adults and its relationship with sagittal dentoskeletal pattern and age. The results of this study could help customize treatment plans for orthodontics, orthognathic surgery, and facial cosmetic surgery according to people's ethnic, racial, and cultural characteristics.

Material and Methods

The protocol of this cross-sectional study was approved by the Ethics Committee of Zanjan University of Medical Sciences. The study sample consisted of lateral cephalometric radiographs of 300 Iranians (201 women and 99 men), acquired in 2022 from the records of a private radiology center in Zanjan city based on the following criteria:

- Recorded in natural head position.
- Good resolution of cephalometric landmarks and nasal structure.
- Age range 18-30 years.
- No craniofacial deformities.
- No history of orthodontic treatment.
- No history of facial surgery or trauma.
- No history of tooth extraction except wisdom teeth.

AudaxCeph software version 6 (Ljubljana, Slovenia) was used for tracing and cephalometric analysis. Nasal and cephalometric landmarks used are shown in Figure 1 and described in Table 1. Before analyzing the cephalograms, the accuracy of the positions assigned to these landmarks by the software was verified by a researcher in all samples.

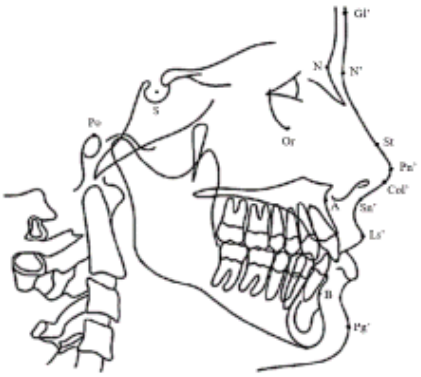

Figure 1. Nasal and cephalometric landmarks used.

The samples were divided into four groups based on the ANB angle and the angle between the SN line and the long axis of the upper incisors (U1) [19]:

- Class I: ANB=3±1°.
- Class II division 1: ANB>4°, U1-SN≥102°.
- Class II division 2: ANB>4°, U1-SN<102°.
- Class III: ANB<2°.

A custom analysis is defined in the software. For this analysis, five linear variables were measured with an accuracy of 0.1 mm and six angular variables were measured with an accuracy of 0.1 degree. (Table 2).

Statistical Analysis

The normality of the distribution of the measured variables was checked through the Kolmogorov-Smirn-

ov test. To compare linear and angular variables in different sagittal dentoskeletal patterns, one-way ANOVA was used. If one-way analysis of variance was significant, Tukey's post hoc test was used for pairwise comparisons of the patterns. Correlation of age with linear and angular variables was investigated through Spearman's correlation coefficient. The analyzes were performed with SPSS software version 26 and the significance level was considered equal to 0.05.

Results

The average age of the examined samples in the different sagittal dentoskeletal patterns is presented in Table 3. Table 4 presents the descriptive information of the parameters measured in the different patterns. Based on one-way ANOVA test, the mean values of nasal depth, Holdaway's nose prominence, nasofacial angle, nasomental angle, nasolabial angle and LNLA were not equal in different sagittal dentoskeletal patterns (Table 4). Pairwise comparisons of these parameters in different patterns were performed using Tukey's post hoc test (Table 5). On this basis, the average nasal depth in Class III subjects was significantly greater than that of Class II div. 1 subjects. Mean Holdaway's nose prominence in Class II div. 2 subjects was significantly higher than in Class II div. 1 subjects. The mean nasofacial angle in Class II subjects was significantly higher than in Class I subjects and in Class I subjects was significantly higher than in Class III subjects. The mean nasomental angle in Class III subjects was significantly higher than in Class I subjects and in Class I subjects was significantly higher than in Class II subjects. Furthermore, the mean nasolabial angle and LNLA in Class II div. 2 subjects were significantly higher than in Class III subjects. The correlation between the measured parameters and the age of the subjects was examined using the Spearman correlation coefficient (Table 6). On this basis, only nasal depth showed a weak positive correlation with age with a correlation coefficient of 0.145.

Table 1. Nasal and cephalometric landmarks used.

landmark	*Tag*	*Description*
Sella Turcica	*S*	*The midpoint of sella turcica or hypophyseal fossa*
Nasion	*N*	*The most anterior point of the frontonasal suture in the middle*
Porion	*Po*	*The most superior point of the external auditory meatus*
Orbitale	*Or*	*The deepest point on the infraorbital margin*
Point A	*A*	*The deepest point on the curved bony outline between the anterior nasal spine and prosthion*
Point B	*B*	*The deepest midline point on the mandible between infradentale and pogonion*
Glabella	*Gl'*	*The most prominent or anterior point in the midsagittal plane of the forehead at the level of the superior orbital ridges*
Soft Nasion	*N'*	*The concave or retruded point in the tissue overlying the area of the frontonasal suture*
Supratip	*St*	*The depression above the tip of the nose on the lower third of the nasal dorsum*
Pronasale	*Pn'*	*The most prominent or anterior point of the nose*
Columella	*Col'*	*The most convex point on the columellar-lobular junction*
Subnasale	*Sn'*	*The point at which the nasal septum between the nostrils merges with the upper cutaneous lip in the midsagittal plane*
Labrale Superior	*Ls'*	*The most anterior point on the margin of the upper membranous lip*
Soft Pogonion	*Pg'*	*The most prominent or anterior point on the soft tissue chin in the midsagittal plane*

DOI: 10.18502/jcr.v11i4.18711

Table 2. Linear and angular parameters measured.

Linear parameters	
Nasal length	*The distance between N' and Pn'*
Nasal depth	*The perpendicular distance between Pn' and the line drawn through N' to Sn'*
Nasal height	*The distance between N' and Sn'*
Nasal hump	*The perpendicular distance between the most superior point of the upper part of the nasal dorsum and the line drawn through N' to St*
Holdaway's nose prominence	*The distance from a line perpendicular to the Frankfurt horizontal plane (Po-Or) and running tangent to the upper lip (Ls') to the tip of nose*
Angular parameters	
Nasofacial angle	*The angle between Gl'-Pg' line and N'-Pn' line*
Nasomental angle	*The angle constructed by the N'-St line and the Pn'-Pg' line*
Nasofrontal angle	*The angle between the lines Gl'-N' and N'-St*
Nasolabial angle	*The angle formed by the intersection of the Col' tangent and the upper lip (Ls') tangent*
Upper Nasolabial Angle (UNLA/Nasal upward tip angle)	*the postero-inferior angle formed when Sn'-Col' line is extended anteriorly to intersect the Frankfurt horizontal plane*
Lower Nasolabial Angle (LNLA/upper lip inclination)	*the antero-inferior angle formed by the Sn'-Ls' line extended superiorly to intersect the Frankfurt horizontal plane*

Table 3. Number of samples and mean age by group.

	N	*Mean age ± SD*
Class I	*94*	*22.96±3.82*
Class II div. 1	*71*	*23.15±3.67*
Class II div. 2	*82*	*22.77±3.62*
Class III	*53*	*23.08±3.54*
Total	*300*	*22.97±3.67*

Table 4. Descriptive statistical results of measured parameters and one-way ANOVA significance.

Variable		*Total*	*Class I*	*Class II div. 1*	*Class II div. 2*	*Class III*	*P*
Nasal length	*Minimum*	*38.7*	*38.7*	*41.2*	*39.9*	*39.6*	*0.676*
	Maximum	*66.1*	*66.1*	*59.5*	*56.9*	*56.6*	
	Mean ± SD	*48.30±4.00*	*47.89±4.33*	*48.38±3.63*	*48.46±3.85*	*48.65±4.16*	
	Median	*48.1*	*47.8*	*48.5*	*48.05*	*48.3*	
	Quartiles	*45.6-51.1*	*44.6-50.65*	*45.9-50.6*	*45.6-51.3*	*45.75-52.05*	
Nasal depth	*Minimum*	*12.6*	*13.6*	*13.3*	*12.6*	*13.3*	*0.034*
	Maximum	*22.7*	*22.7*	*22.2*	*20.6*	*22.2*	
	Mean ± SD	*16.71±1.76*	*16.76±1.71*	*16.20±1.69*	*16.89±1.77*	*17.03±1.85*	
	Median	*16.65*	*16.75*	*16.3*	*16.8*	*16.8*	
	Quartiles	*15.5-17.7*	*15.475-17.85*	*15.0-16.9*	*15.675-18.15*	*15.9-17.9*	
Nasal height	*Minimum*	*44.4*	*45.5*	*44.9*	*44.4*	*44.5*	*0.594*
	Maximum	*68.1*	*68.1*	*62.5*	*61.2*	*61.0*	
	Mean ± SD	*52.58±3.69*	*52.31±3.81*	*52.40±3.63*	*52.70±3.53*	*53.13±3.86*	
	Median	*52.3*	*51.8*	*52.2*	*52.7*	*53.1*	
	Quartiles	*50.1-55.0*	*49.25-54.8*	*50.0-54.6*	*50.275-55.1*	*50.4-55.9*	
Nasal hump	*Minimum*	*-1.7*	*-1.7*	*-1.3*	*-1.0*	*-0.6*	*0.193*
	Maximum	*3.2*	*3.2*	*2.4*	*2.3*	*2.7*	
	Mean ± SD	*0.57±0.77*	*0.60±0.81*	*0.49±0.74*	*0.50±0.71*	*0.76±0.79*	
	Median	*0.5*	*0.6*	*0.3*	*0.5*	*0.7*	
	Quartiles	*0.0-1.1*	*0.1-1.025*	*0.0-1.1*	*0.0-1.0*	*0.05-1.4*	

Variable		Total	Class I	Class II div. 1	Class II div. 2	Class III	P
Holdaway's nose prominence	Minimum	5.5	7.5	5.5	7.8	6.1	0.009
	Maximum	24.6	24.2	24.3	24.6	21.1	
	Mean±SD	14.20±3.07	14.33±2.92	13.31±3.36	14.96±3.03	13.97±2.75	
	Median	14.1	14.2	13.0	15.0	13.9	
	Quartiles	12.1-16.2	12.4-16.15	11.1-14.5	13.175-16.8	12.35-15.35	
Nasofacial angle	Minimum	24.6	26.8	28.6	28.2	24.6	<0.001
	Maximum	46.1	41.7	41.9	46.1	39.5	
	Mean±SD	35.00±3.76	34.54±3.45	36.10±3.02	36.53±3.61	32.00±3.56	
	Median	35.05	34.45	36.6	36.05	32.1	
	Quartiles	32.325-37.6	31.8-36.9	33.8-38.4	34.15-38.85	28.95-34.4	
Nasomental angle	Minimum	110.2	114.4	113.1	110.2	121.5	<0.001
	Maximum	142.6	138.8	134.4	135.3	142.6	
	Mean±SD	124.99±5.65	125.91±4.53	122.86 ± 4.57	122.11±5.18	130.65±4.83	
	Median	124.75	125.75	122.6	122.55	130.8	
	Quartiles	121.3-128.75	122.75-129.45	119.8-125.7	118.825-125.825	127.3-133.85	
Nasofrontal angle	Minimum	115.5	118.7	117.0	124.1	115.5	0.816
	Maximum	161.7	151.6	147.6	153.5	161.7	
	Mean±SD	136.80±7.49	136.81±7.89	136.26±6.79	137.40±7.19	136.57±8.20	
	Median	137.3	138.15	136.2	138.3	135.8	
	Quartiles	131.7-142.275	132.325-142.7	132.1-141.3	130.575-142.65	130.55-142.25	
Nasolabial angle	Minimum	68.3	77.3	84.9	77.9	68.3	0.017
	Maximum	126.5	123.6	126.5	125.1	124.7	
	Mean±SD	101.49±9.87	101.96±10.05	101.91±8.12	103.05±9.52	97.71±11.42	
	Median	101.6	102.9	101.0	103.9	96.7	
	Quartiles	95.075-108.175	95.85-109.55	96.8-106.5	97.875-109.5	91.2-106.1	
UNLA	Minimum	-3.8	2.0	3.9	-3.8	-0.8	0.217
	Maximum	32.4	32.4	32.4	29.0	29.4	
	Mean ± SD	15.30±6.71	15.45±6.81	16.53±5.72	14.85±6.39	14.10±8.01	
	Median	15.55	14.95	16.4	15.4	15.6	
	Quartiles	10.65-19.6	10.45-19.625	12.4-20.3	10.15-18.9	6.95-20.0	
LNLA	Minimum	63.7	63.7	68.5	74.4	66.0	0.006
	Maximum	111.2	106.6	105.1	111.2	103.9	
	Mean ± SD	86.19±7.75	86.50±7.88	85.39±7.51	88.19±7.12	83.59±8.07	
	Median	86.75	87.15	86.0	88.2	84.8	
	Quartiles	81.025-91.075	81.3-92.4	79.8-89.2	82.625-93.375	78.9-88.3	

Table 5. Significance between groups (Tukey test after one-way ANOVA).

Variable	Class I and Class II div. 1	Class I and Class II div. 2	Class I and Class III	Class II div. 1 and Class II div. 2	Class II div. 1 and Class III	Class II div. 2 and Class III
Nasal depth	0.180	0.958	0.801	0.073	0.046*	0.969
Holdaway's nose prominence	0.144	0.511	0.903	0.005*	0.625	0.251
Nasofacial angle	0.021*	0.001	<0.001*	0.861	<0.001*	<0.001*
Nasomental angle	<0.001*	<0.001*	<0.001*	0.770	<0.001*	<0.001*
Nasolabial angle	1.000	0.881	0.057	0.889	0.085	0.011*
LNLA	0.790	0.456	0.121	0.107	0.568	0.004*

*Difference is significant.

DOI: 10.18502/jcr.v11i4.18711

Table 6. Correlation significance of measured parameters and age (Spearman correlation coefficient).

Variable	*Nasal length*	*Nasal depth*	*Nasal height*	*Nasal hump*	*Holdaway's nose prominence*	*Nasofacial angle*	*Nasomental angle*	*Nasofrontal angle*	*Nasolabial angle*	*UNLA*	*LNLA*
P	*0.156*	*0.012**	*0.068*	*0.327*	*0.994*	*0.628*	*0.380*	*0.942*	*0.639*	*0.198*	*0.258*

*Correlation is significant.

Discussion

In recent years, many opinions have been expressed in various resources about what constitutes an attractive face [20]. The nose forms the main part of the midface and, in harmony with the lips and chin, determines the appearance of a person's face. To achieve desired treatment goals, physicians must have a comprehensive knowledge of the relationship between facial structures and expected changes during and after growth [21,22]. By examining the relationship between nasal morphology and sagittal dentoskeletal classification, it was found that the mean value of nasomental angle in Class III subjects was significantly greater than that in Class I subjects, and also greater in Class I subjects compared with Class II subjects. Jankowska et al. [23] showed that this angle is larger in Class III subjects than in Class I and Class II subjects.

In our study, similar to the studies of Prasad et al. [11] and Thakur et al. [24], no significant relationship was found between nasal hump and sagittal dentoskeletal pattern. This finding contrasts with a number of previous studies showing that Class I subjects have flat noses, Class II subjects have convex noses, and Class III subjects have concave noses [12,25-27]. In the present study, no significant relationship was found between nasal length and sagittal dentoskeletal classification. This finding is in contrast to the studies of Bhardwaj et al. [28] and Chaconas et al. [12].

They concluded that the length of the nose is increased in Class III subjects. In the study by Chaconas et al. [12], the mean values of nasal upward tip angle and nasal depth had no significant relationship with the sagittal dentoskeletal classification. The same conclusion was reached for nasal upward tip angle in this study, but the average nasal depth in Class II div. 1 subjects was significantly lower than in Class III subjects. In our study, no significant relationship was found between mean nasofrontal angle and sagittal dentoskeletal classification. Furthermore, the mean nasofacial angle was significantly lower in class III subjects than in class I subjects, and significantly lower in class I subjects than in class II subjects. These findings are completely consistent with the results of the study by Perović et al. [13]. In our study, the mean value of the nasolabial angle in Class II div. 2 subjects was significantly higher than in Class III subjects. However, in some other studies, no significant relationship was found between the mean value of this angle and the sagittal dentoskeletal classification [13,23]. The mentioned differences may be due to differences in ethnicity, sample size, and average age of the study population. Among the linear and angular parameters considered in this study, only nasal depth had a significant positive correlation with age. While studies have shown that the majority of nasal development is completed by the age of 16 in females and by age 18 in males [10], our results indicate that nasal growth persists beyond the age of 18. This is consistent with the studies by Meng et al. [29] and Chaconas et al. [12], which concluded that nose growth continues after age 18, although to a lesser extent in women than in men.

Studying the nasal profile requires clear visualization of the soft tissue profile as well as the underlying hard tissues in standard positions, best demonstrated by cephalometric imaging. Nontherapeutic exposure to ionizing radiation is unacceptable and unethical, especially when information can be obtained from previously recorded and archived cephalometric radiographs [30]. Therefore, the design of the present study allowed us to obtain a large number of samples using cephalograms of orthodontic patients available in the archives without exposing individuals to nontherapeutic X-rays. Formerly, manual tracing was considered the method of choice for accurate analysis of lateral cephalograms; However, today the use of computer software has become widespread. Studies have shown that both digital and manual methods are reliable and that statistical differences between digital and manual tracing techniques are not clinically significant [31]. Therefore, AudaxCeph version 6.1.4.3951 was used in this study.

Conclusion

In the examination of nose profile and its relationship with sagittal dentoskeletal pattern and age in Iranian adults, the following results were obtained:

• The mean values of nasal depth, Holdaway`s nose prominence, nasofacial angle, nasomental angle, nasolabial angle and LNLA were not equal in different sagittal dentoskeletal patterns. By pairwise comparisons of these parameters in different patterns, the mean nasal depth in Class III individuals was significantly higher than in Class II div. 1 individuals. The mean of Holdaway's nose prominence in Class II div. 2 subjects was significantly higher than in Class II div. 1 subjects. The mean nasofacial angle in Class II subjects was significantly higher than in Class I subjects and in Class I subjects was significantly higher than in Class III subjects. The mean nasomental angle in Class III subjects was significantly higher than in Class I subjects and in Class I subjects it was significantly higher than in Class II subjects. Furthermore, the mean nasolabial angle and LNLA were significantly higher in Class II div. 2 subjects than in Class III subjects.

• In examining the correlation of measured linear and angular parameters with the age of subjects, only Nasal depth showed a weak positive correlation with age with a correlation coefficient of 0.145.

Conflict of Interest

There is no conflict of interest to declare.

References

[1] Little AC, Jones BC, DeBruine LM. Facial attractiveness: evolutionary based research. Philosophical Transactions of the Royal Society B: Biological Sciences. 2011; 366(1571):1638-59. https://doi.org/10.1098/rstb.2010.0404.

[2] Ferneini EM. Facial cosmetic surgery. Journal of Oral and Maxillofacial Surgery. 2021;79(9):1977-8. https://doi.org/10.1016/j.joms.2021.06.017

[3] Hopkins ZH, Moreno C, Secrest AM. Influence of social media on cosmetic procedure interest. The Journal of clinical and aesthetic dermatology. 2020; 13(1):28.

[4] Plastic surgery statistics report 2022. American Society of Plastic Surgeons (ASPS); 2022.

[5] Arian H, Alroudan D, Alkandari Q, Shuaib A. Cosmetic surgery and the diversity of cultural and ethnic perceptions of facial, breast, and gluteal aesthetics in women: a comprehensive review. Clinical, Cosmetic and Investigational Dermatology. 2023:1443-56.

[6] Jefferson Y. Facial beauty-establishing a universal standard. INTERNATIONAL JOURNAL OF ORthodontics-Milwaukee-. 2004; 15(1):9-26.

[7] Saraswathi P. The golden proportion and its application to the human face. European Journal of Anatomy. 2007; 11(3):177.

[8] Sahoo R, Parihar AV, Chaturvedi T, Verma S. Relationship of Nasal Morphology With Different Dentoskeletal Patterns: A Systematic Review. Journal of Indian Orthodontic Society. 2021; 55(2):122-37. https://doi.org/10.1177/0301574221992189

[9] Sturm-O'Brien AK, Brissett AE, Brissett AE. Ethnic trends in facial plastic surgery. Facial Plastic Surgery. 2010; 26(02):069-74.

[10] Nehra K, Sharma V. Nasal morphology as an indicator of vertical maxillary skeletal pattern. Journal of Orthodontics. 2009; 36(3):160-6. https://doi.org/10.1179/14653120723148.

[11] Prasad M, Chaitanya N, Reddy KPK, Talapaneni AK, Myla VB, Shetty SK. Evaluation of nasal morphology in predicting vertical and sagittal maxillary skeletal discrepancies'. European journal of dentistry. 2014; 8(02):197-204. https://doi.org/10.4103/1305-7456.130600

[12] Chaconas SJ. A statistical evaluation of nasal growth. American journal of orthodontics. 1969; 56(4):403-14.https://doi.org/10.1016/S0002-9416(69)80007-2.

[13] Perović T, Blažej Z, Jovanović I. The influence of antero-posterior dentoskeletal pattern on the value of nasal soft tissue angles: A cephalometric study. Folia Morphologica. 2021; 80(3):657-64.

[14] Robison JM, Rinchuse DJ, Zullo TG. Relationship of skeletal pattern and nasal form. American journal of orthodontics. 1986; 89(6):499-506. https://doi.org/10.1016/0002-9416(86)90008-4.

[15] Amini F, Razavian ZS, Rakhshan V. Soft tissue cephalometric norms of Iranian class I adults with good occlusions and balanced faces. International orthodontics. 2016; 14(1):108-22. https://doi.org/10.1016/j.ortho.2015.12.003.

[16] Atashi MHA, Kachooei M. Soft tissue cephalometric standards based on NHP in a sample of Iranian adults. Journal of dental research, dental clinics, dental prospects. 2008; 2(2):53. https://doi.org/10.5681%2Fjoddd.2008.011.

[17] Rakhshan V, Ghorbanyjavadpour F. Anteroposterior and vertical soft tissue cephalometric norms of Iranians, interethnic comparisons, sex dimorphism, and the effect of age on cephalometric variables. Oral and maxillofacial surgery. 2019; 23:167-78. https://doi.org/10.1007/s10006-019-00755-4.

[18] Taki AA, Oguz F, Abuhijleh E. Facial soft tissue values in Persian adults with normal occlusion and well-balanced faces. The Angle Orthodontist. 2009; 79(3):491-4. https://doi.org/10.2319/020408-62.1.

[19] Soheilifar S, Alafchi B, Molabashi V, Banisafar Z. Is There Any Difference in the Outcome of Growth Modification Treatment Between Class II Division 1 and 2 Malocclusions? Avicenna Journal of Dental Research. 2019; 11(2):48-52.

[20] Shaw WC. The influence of children's dentofacial appearance on their social attractiveness as judged by peers and lay adults. American journal of orthodontics. 1981; 79(4):399-415. https://doi.org/10.1016/0002-9416(81)90382-1.

[21] Arnett GW, McLaughlin RP. Facial and dental planning for orthodontists and oral surgeons. (No Title). 2004.

[22] CHACONAS SJ, BARTROFF JD. Prediction of normal soft tissue facial changes. The Angle Orthodontist. 1975; 45(1):12-25. https://doi.org/10.1043/0003-3219(1975)045%3C0012:PONSTF%3E2.0.CO;2.

[23] Jankowska A, Janiszewska-Olszowska J, Grocholewicz K. Nasal morphology and its correlation to craniofacial morphology in lateral cephalometric analysis. International Journal of Environmental Research and Public Health. 2021; 18(6):3064. https://doi.org/10.3390/ijerph18063064.

[24] Thakur G, Singla A, Jaj H, Mahajan V, Negi P, Justa A. To evaluate relationship between craniofacial structures and nose in Himachali ethnic population. Indian Journal of Dental Sciences. 2016; 8(4):193-8. https://doi.org/10.4103/0976-4003.196815.

[25] Khare V, Niwlikar KB. Effect of vertical maxillary skelatal pattern on nasal morphology in high and low angle cases. Int J Oral Health Med Res. 2017; 3(6):75-9.

[26] Kothari Y. Growth/size of the nose in different skeletal and dental patterns. Master's thesis, Eastman Dental Center, Rochester, NY. 1981.

[27] Wisth P. Nose morphology in individuals with Angle Class I, Class II or Class III occlusions. Acta Odontologica Scandinavica. 1975; 33(1):53-7. https://doi.org/10.3109/00016357509004627.

[28] Bhardwaj A, Maurya R, Nehra K, Mitra R, Kamat U, Nakra O. Comparative evaluation of various nasal parameters in different malocclusion and growth patterns: a cross-sectional study. Journal of Indian Orthodontic Society. 2018; 52(4):243-7. https://doi.org/10.4103/jios.jios_24_18.

[29] Meng HP, Goorhuis J, Kapila S, Nanda RS. Growth changes in the nasal profile from 7 to 18 years of age. American Journal of Orthodontics and Dentofacial Orthopedics. 1988; 94(4):317-26. https://doi.org/10.1016/0889-5406(88)90057-1.

[30] Sarilita E, Rynn C, Mossey PA, Black S, Oscandar F. Nose profile morphology and accuracy study of nose profile estimation method in Scottish subadult and Indonesian adult populations. International Journal of Legal Medicine. 2018; 132:923-31. https://doi.org/10.1007/s00414-017-1758-4.

[31] Albarakati S, Kula K, Ghoneima A. The reliability and reproducibility of cephalometric measurements: a comparison of conventional and digital methods. Dentomaxillofacial Radiology. 2012; 41(1):11-7. https://doi.org/10.1259/dmfr/37010910.