ORIGINAL REPORT

Evaluation of Nasomaxillary Growth of Adolescent Boys in Northeastern Iran

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Abstract- Anthropometry, a useful method for evaluating craniofacial soft tissues, makes the quantitative description of the face possible. It also assesses the degree of disharmony and imbalance in the growth and development of the face. The aim of this study was to examine the overall common age-related changes of nasomaxillary complex of adolescent boys in northeast Iran. Three- hundred- twelve 12 to 15 year-old boys voluntarily participated in this study. They were divided into three age groups (12-13, 13-14 and 14-15 year-old groups). Digital photographs of the subjects' faces were taken in Natural Head Position (NHP) frontal and profile views. After determination of the landmarks, nine anthropometric parameters including nasal length, mouth width, alar width, columella width, philtrum height, nasal width, nasolabial angle, nasal root slope angle and nasal index were measured by the Smile Analyzer software considering the magnification ratio of each image. One way ANOVA and Tukey test were used for statistical analyses. Significant differences between the three groups were detected in the mean alar, mouth and philtrum widths, nose length, nasolabial angle and nasal index ($P<0.05$). We did not find any significant differences in the mean nasal-root-slope angle and the mean philtrum height between the groups ($P=0.29$ and $P=0.13$, respectively). Aging of the facial profile is not a gradual process; it occurs in spurts and at different periods of life. During the studied time span, significant growth in nose width and nose length was obvious.

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Keywords: Adolescent; Anthropometry; Growth; Nose; Maxilla

Introduction

Anthropometry is a useful method for evaluating craniofacial soft tissues, which will make the quantitative description of the face possible and assesses the degree of disharmony and imbalance in the development. Today, this method has become one of the morphometric tools similar to cephalometric analysis and radiographic analysis of the wrist (1).

The shape and composition of the anatomic structures in various races and ethnicities are different from each other. Thus, reconnaissance of the development of facial structures and determination of normal and abnormal faces in each nation, not only can help the medical scientists to diagnose and treat facial malformations, but can also be helpful in anthropometric field in order to differentiate ethnicities and their attributes.

Many research workers have done morphological and anthropometric researches on the upper lip. Farkas *et al.* (2) made facial measurements of 6 to 18- year- old North Americans. Cho *et al.* (3) studied the anthropometry of the upper lip and nose of less than a-year- old infants in Korea. Characteristics, morphometry and esthetics of lips are different for different ages, places and races. Although facial analysis and proportions are well discussed in whites (1,2,4) and African Americans (5-8), only a limited number of studies exist for Asians (9-12). The main purpose of this study was to evaluate nasomaxillary growth of adolescent boys in northeast Iran.

Materials and Methods

In this cross-sectional study a sample of 312 twelve to fourteen-year- old boys was selected from guidance schools in Mashhad, Iran by stratified cluster

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randomized sampling technique. The schools were stratified by housing density and housing/living conditions of each school district. Nine schools were selected randomly and random number tables were used to select the boys within the schools. The questionnaires were delivered to parents by the pupils with a cover letter requesting that the forms be completed by the mother (with the assistance of a literate family member if necessary). The questionnaire included questions about previous history of trauma to the head and face, cleft lip and palate or cosmetic surgery. In addition, parents signed informed consents before their children participated in this study.

The results from the questionnaires were reviewed by the authors and if any question had not been answered, the questionnaires were excluded and replacement students were selected from the same schools.

After subject selection, the authors examined subjects' face and dentition for facial asymmetry, aesthetics and proportions, skeletal and dental relationships in transverse, antero-posterior and vertical dimensions. All the subjects had Class I skeletal and dental relationships and permanent dentition. If they had extensive tooth decay or extractions, they were excluded from the study. Overweight children were not included either. Finally, 312 boys were selected and divided into three age groups: 12-13-year- old (n=109), 13-14-year-old (n=106), and 14-15-year-old (n=98) groups.

A D40 Nikon digital camera with 18/135 lens (Nikon inc., Japan, 2007) was used to take frontal and lateral photographs of each child's face while his head was in natural head position (NHP). The samples were relaxed during imaging and no special facial expressions such as smiling, laughing or frowning were detectable in their faces (13,14). A 10-mm wide sticker on each sample forehead was employed to calculate the image magnification.

The images transferred to a computer and classified according to the age of samples. Using Adobe Photoshop software (Adobe Inc., USA), the points indicating the desired anthropometric landmarks were put on each image. Newly developed software by the Orthodontic Department of Mashhad Dental School called "Smile Analyzer" was used to measure the anthropometric parameters on each image (15). This software has specifically been designed for precise measuring of desired distances or angles on images and radiographs. After taking photographs, head posture of the subjects was controlled and if there was any problem the image was excluded. Seven following landmarks were marked on each subject's lateral and frontal views (Figure 1):

1. Alare (al) the most lateral point of each alar contour.
2. Cheillion (ch) the point located at each labial commissure.
3. Nasion (n) the point in the midline of nasofrontal suture.
4. Subnasale (sn) the midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet.
5. Crista Philtri Landmark (cph) is the point on each elevated margin of the philtrum just above the vermilion line.
6. Subnasale' (sn') indicates the midpoint of the columella crest where the thickness of the columella is measured.
7. Pronasale (prn) the most protruded point of the apex nasi identified in lateral view of the rest position of the head.

Linear measurements on frontal photographs in this study were total nasal length (n-sn), mouth width (ch-ch), alar width (al-al), columella width (cph-cph), philtrum height (cph-sn'), and nasal width (sn'-sn').

Angular measurements on profile photographs were nasolabial angle (angle between philtrum and nasal septum) and nasal root slope angle (sn-n-prn).

We also calculated nasal ratio through following equation:

$$Nasal\ ratio = (al\text{-}al \times 100)/n\text{-}sn$$

Data were analyzed using one-way ANOVA and Tukey test of the SPSS software (SPSS Inc., Chicago, USA). The level of significance was less than 0.05.

Results

The nasolabial complex of 312 Iranian boys was analyzed statistically. Ninety eight of the subjects (31.4%) were 14-15 years old, 106 (33.9%) of the participants were 13-14 years old, and 108(34.6%) of the subjects were 12-13 years old. Table 1 shows the mean and SD of measured parameters by age. According to Table 1, all measured parameters were gradually increased between 12-15 years old except cph-sn' that increased after 14. For alar width, a mild increase in mean values was observed between 12 to 15. However, one-way analysis of variance showed significant differences between three age groups ($P<0.001$) and Tukey test also revealed significant differences between 13-14 and 14-15 year-old and between 12-13 and 14-15 year-old groups. According to Table 1, a small increase was observed in mouth width (ch-ch) between the ages

Table 1. Mean and SD of measured parameters by age.

Anthropometric measurements (mean±SD) / Age (years)	12-13 N=108	13-14 N=106	14-15 N=98	One-way ANOVA
al-al (mm)	29.14±2.1	29.75±2.1	31.04±2.44	F=19.12 *P*-value<0.001
ch-ch (mm)	37.59±2.7	39.01±3.5	40.13±3.1	F=16.85 *P*-value<0.001
n-sn (mm)	40.34±2.61	40.44±3.02	41.62±2.9	F=6.23 *P*-value=0.002
cph-cph (mm)	10.20±1.77	10.76±1.41	11.33±1.9	F=11.22 *P*-value<0.001
cph-sn'(mm)	15.97±1.6	15.89±1.9	16.38±1.9	F=2.04 *P*-value=0.13
sn'-sn'(mm)	20.67±2.07	20.97±2.05	21.96±2.17	F=10.45 *P*-value<0.001

12 to 15 (approximately 2.5 mm). ANOVA showed significant differences between three groups for this anthropometric parameter (P<0.001) and Tukey test showed the differences between 13-14 and 14-15 year-old groups (P=0.034), 12-13 and 14-15-year-old groups (P<0.001) and 12-13 and 13-14-year-old groups (P=0.003) were significant.

The result of this study showed that nose height (n-sn) was increasing gradually and the differences were also significant (P=0.002). According to Tukey test there was a significant difference between 13-14 and 14-15-year-old groups (P=0.01) and between 12-13 and 14-15-year-old-groups (P=0.004) but there were no significant differences between 12-13 and 13-14- year-old groups (P=0.96).

Table 1 shows the mean values of philtrum height(cph-sn') between the groups. Although the results showed philtrum height was slowly decreased between 12-13 to 13-14 groups and increase after that, one ANOVA showed no significant differences between three age groups (P=0.13).

Philtrum width (cph-cph) was significantly different between three age groups (P<0.001). Tukey test showed significant differences between 13-14 and 14-15-year-old (P=0.046) , between 12-13 and 14-15-year-old (P<0.001) and between 12-13 and 13-14-year old groups (P=0.046).

According to one way ANOVA, mean nose width (sn'-sn') in three age groups was significantly different (P<0.001). Tukey test indicated significant differences between 13-14 and 14-15 (P=0.002), 12-13 and 14-15-year-old groups (P<0.001). There were no difference between 12-13 and 13-14-year old groups (P=0.557).

According to Table 2 mean nasolabial angle between 12 and 14 years of age was slowly increased. However, after that the angle was decreased approximately five degrees. One-way ANOVA showed significant differences among three groups (P=0.019) and according to Tukey test there was a significant difference between 13-14 and 14-15 year- old groups (P=0.016) but the differences between 12-13 and 14-15 (P=0.116) and between 12-13 and 13-14 year-old groups were not significant (P=0.7).

Table 2. Mean and SD of nasolabial angle, nasal root slob angle and nasal index by age.

Anthropometric measurements (mean ± SD) / Age group(years)	12-13 N=108	13-14 N=106	14-15 N=98	*P-value (f)*
Nasolabial angle(degree)	105.44 ± 13.16	106.92 ± 12.91	101.69 ± 14.35	0.01(4.04)
Nasal Root-Slope angle(degree)	21.52 ± 2.6	21.66 ± 2.2	22.02 ± 2.14	0.29 (1.23)
Nasal index (%)	72.5 ± 6.59	73.89 ± 6.69	74.87 ± 7.13	0.04 (3.18)

Figure 1. Anthropometric landmarks in frontal and lateral views.

The mean nasal-root-slope angle among the groups is shown in Table 2. One-way ANOVA showed no significant differences between 12-13, 13-14 and 14-15 year-old groups (P=0.29).

Although mean nasal index raised from 72.5±6.5 in 12-13 year-old to 74.8±7.1 mm in 14-15 year-old group, there was a significant difference among three groups (P=0.04).According to Tukey test, although there was a significant difference between 12-13 and 14 -15 year-old groups (P=0.03), differences between 13-14 and 14-15 year-old groups (P=0.56) and between 12-13 and 13-14 year-old groups were not significant (P=0.295).

Discussion

Facial beauty arises from symmetric, balanced and harmonious proportions. Reestablishment of facial harmony requires restoration of proportional facial structures and elimination of disproportionate relationships. The optimal relationships between facial structures are used to assess the face during esthetic and reconstructive consultations.

Although minor differences in facial features exist within a specific ethnic or racial group, the overall facial structures are different among ethnic and racial groups. A single facial esthetic concept is too simple and rigid to describe the qualitative differences among different racial-ethnic facial features. Rather, several guides sensitive to differences in facial features across different cultures are necessary. Although facial analysis in whites is widely available only a limited number of such studies on Asian and especially Iranian faces have been conducted.

In the current study, nine anthropometric parameters of nasolabial complex were assessed in a group of healthy Iranian boys aged 12 to 15 years. The reason to limit the age of the samples to 12-15 is that at this age the growth and development spurt of the craniofacial structures in boys occurs. Also it is the age of translation from primary to permanent dentition which makes the jaw and labial complex balanced. The quantitative assessment of their three dimensional characteristics can provide useful information for diagnosis, treatment planning and evaluation of medical and surgical treatments. The aim of this study was to examine the overall common age-related changes of nasomaxillary complex in adolescent boys.

According to the results, increase in philtrum height, alar width, mouth width, nose length and columella width were significantly different in three age groups ($0.01<P<0.001$).

In this study there was no significant difference in the philtrum height between the three groups which may indicate that a greater range of age is possibly necessary in order to determine the peak of the lip growth.

There was no significant difference in nasolabial angle between 12 -13and 13-14 year-old groups, but a significant decrease from 13-14 to 14-15 age range was obvious.

This may be attributed to downward nasal growth from 13 to 15 years followed by a decrease in angle after 14.

We also find no significant difference in nasal-root slope angle among three groups; this indicates that the angle does not change significantly in this age period.

Nasal index changes was not significant from 12-13 to 13-14 and from 13-14 to 14-15, but there was a significant change from 12-13 to 14-15, which indicates a significant growth in the 2 year interval is expected.

A study on Turkish children had reported that the nasal length and nasal bridge length became fully mature in males at age of 15. This study showed that the nose maturation begins at 13-14, so this proves that the age of nose maturation in Iranians and Turks is similar. They also reported that during maturation the lower dorsum slightly rotated forward. This is in agreement with the decrease of nasolabial angle reported in our study (16).

Comparison to white North Americans, in Iranians, nose width and philtrum width is wider, mouth width is narrower, and nose length is shorter. Nasal index shows that in American, there is a proportional growth in the nose length and width while in Iranians, more growth in the nose width than length is expected[1]. All this differences are because of differences in racial, environmental and genetic conditions which suggest that anthropometric standards of white North Americans are not applicable in Iranians. In conclusion, aging of the facial profile is not a gradual process; it occurs in spurts and at different periods of life. Between 12 to 15 years of age in Iranian adolescent boys, significant growth in nasal width and length was obvious. In contrast, philtrum height, nasal root slope angle and nasal index did not alter significantly.

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