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Gender differences of the external nose in Bulgarians examined by 3D laser scanning

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The aim of the study was to investigate the morphology of the external nose in young healthy male and female individuals of Bulgarian origin. Thirty nine subjects (16 male and 23 female) were included in the study. Their mean age was 26 years, mean weight – 70 kg and mean height – 172 cm. The surface of the face was scanned by a laser scanner (FastSCAN) with the head in Frankfort horizontal plane. The following anthropometric points were marked on the three-dimensional model: n, prn, sn and al (right and left). Each point was characterized by x, y and z values. The following measurements were calculated: volume of the external nose (mm^3), areas of nasal surfaces (mm^2), linear distances (mm), and angles (degrees). It was found that male nasal dimensions were greater than female and all measurements demonstrated racial differences.Sexual dimorphism is found in nasal width, volume of the external nose and areas of nasal surfaces.

Key words: gender differences, external nose, 3D laser scanning, Bulgarians, three-dimensional model

Introduction

The external nose is a human body structure that undergoes dynamic changes throughout life. It has relevance to various diagnostic, clinical and forensic procedures [1]. A number of cross-sectional and longitudinal investigations by foreign authors found that older individuals possessed noses with larger dimensions compared to younger people of the same sex and race. The external nose was also found to be larger in men than in women of the same age and race group [2, 3, 4]. Abnormal nose form and dimensions are found in congenital anomalies of the upper lip and palate, in certain genetic disorders like Down's syndrome and hypohidrotic ectodermal dysplasia [5, 6]. Detailed assessment of the nasal morphology is especially important for the

restoration of the facial profile by surgical reconstructive procedures. The changes of nasal form and dimensions associated with sex and age could be of help for forensic anthropologists in the identification of alive or diseased people. The aim of the present study was to investigate the morphology of the external nose in young healthy male and female individuals of Bulgarian origin. The mean dimensions were to be compared with the results from investigations by foreign authors on different population groups of the same age and sex. Another aim of the study was to look for association between some dimensions of the nose and height and weight of the studied individuals.

Material and methods

Thirty nine subjects (16 male and 23 female) were included in the study. Their mean age was 26 years, mean weight was 70 kg and their mean height – 172 cm. The subjects were selected to be above 20 years because of the slower rate of nasal change after this age as well as more pronounced gender differences in nasal shape and dimensions. The exclusion criteria were as follows: cranio-maxillofacial trauma, congenital anomalies, surgical interventions in the nasal area, genetic and psychiatric disorders. The surface of the face was scanned by a laser scanner (FastSCAN) with the head in standard position (Frankfort horizontal plane). The following anthropometric points were marked on the three-dimensional model: n, prn, sn and al (right and left). Each point was characterized by x, y and z values. The method was generally based on the so-called geometric morphometry [19, 20]. The separate objects in space are characterized by specific shape and size. For example a football and a tennis ball have the same shape but different size, whereas a balloon with certain size can have different shapes depending on modeling [19]. Therefore both shape and size must be taken into account in order to compare objects, including the nose.

The following measurements were calculated:

1. Volume of the external nose (mm^3) as the sum of the volumes of two pyramids with a common base (the first pyramid was defined by points n, prn, alr and als (V1) and the second – points sn, prn, alr and als (V2).
2. Areas of nasal surfaces (mm^2) – area of the left lateral side (n-prn-als (S1), area of the right lateral side (n-prn-alr (S2), and the sum of the two areas.
3. Linear distances (mm) – nasal width (alr-als), nasal height (n-sn), length of nasal bridge (n-prn), nasal tip protrusion (sn-prn).

Fig. 1. Anthropometric landmarks on the external nose.

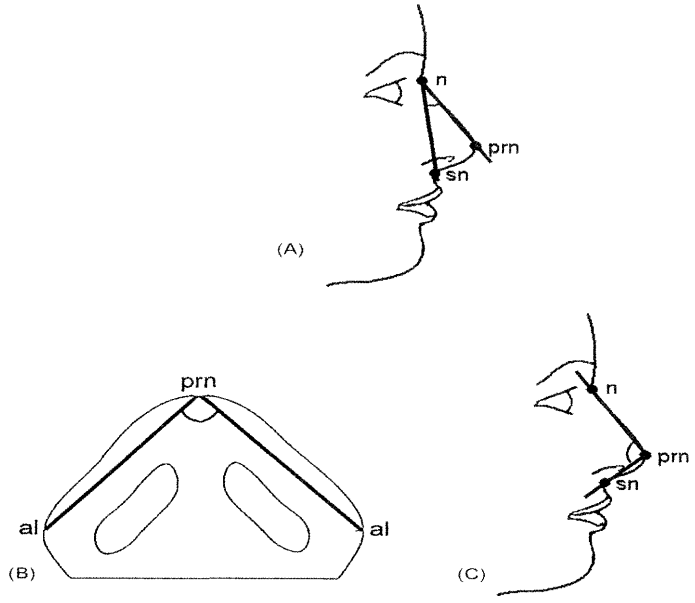

Figure 2. Angels measured.

4. Angles (degrees) – nasal convexity (sn-n-prn) (A1), inter-alar angle (alr-prn-all), nasal tip angle (n-prn-sn) (A3).

The results were analyzed statistically by the SPSS 17.0 software. Paired-samples t-test was used to compare left and right measurements. The distribution of the variables was tested by the Kolmogorov-Smirnov test. The Independent Samples test and Mann-Whitney test were used to analyze the differences between genders, as well as to test for correlation between nasal measurements and height and weight of the subjects. The level of significance was set at $p < 0.05$.

Results

Mean values of the studied variables for both genders are shown in table 1. Table 2 demonstrates results from laser scanning of the faces of healthy Italian and Chinese subjects in the same age group [1, 22].

It was found that male nasal dimensions were greater than female and all measurements demonstrated racial differences. Theses findings confirmed the results in other studies [1, 22].

Paired samples t-test showed no significant difference between S1 and S2 ($p=0.338$), which proved that there was no nasal asymmetry.

All studied variables except V1, A3 demonstrated normal distribution ($p=0.013$, $p<0.001$, $p=0.001$, $p<0.001$).

Significant differences between the following normally distributed variables in males and females were found using independent samples t-test – nasal width, S1, S2, S1 + S2 and V1 + V2. Therefore they can be used to discriminate between sexes (table 2).

Table 1. Volumes, areas and angles measured.

Variable	Males	Females
V1, mm3	6507,9	4421,8
V2,mm3	1085,6	922,77
V1+V2	7593,2	5344,6
S1, mm2	699,16	548,52
S2, mm2	671,35	551,26
S1+S2	1370,5	1099,8
A1, degrees	22,1000	24,3100
A2, degrees	72,97	75,48
A3, degrees	96,15	95,07

Table 2. Linear distances in different ethnicities.

Measurements	Male Bulgarians	Male Italians	Male Chinese	Female Bulgarians	Female Italians	Female Chinese
Nasal width	35,52	32,31	39,49	32,05	28,9	37,63
SD	6,94	3,1	2,95	2,88	3,3	3,47
Nasal height	53,39	55,65	50,15	49,83	51,17	46,93
SD	3,18	3,31	4,16	6,88	3,57	3,3
Nasal bridge length	47,1	51	43,65	44,06	46,46	40,04
SD	4,53	3,91	4,5	5,73	3,99	3,62
Nasal tip protrusion	20,31	19,17	17,68	19,58	17,69	16,69
SD	2,71	2,15	1,66	3	1,92	2,01

Table 3. Variables with significant sexual dimorphism in Bulgarians.

Gender	Male	Female		
N	16	23		
Nasal width	35,52±6,94	32,05±2,88	t=2,152	p=0,038
S1	699,16±177,75	548,52±72,9	t=3,662	p=0,001
S2	671,35±197,95	551,26±94,95	t=2,531	p=0,016
S1+S2	1370,5±369,76	1099,8±154,51	t=3,152	p=0,003
V1+V2	7593,2±4439,3	5344,6±1156,5	t=2,330	p=0,025

The Mann-Whitney test showed that the variable V1, which did not have normal distribution, was also significantly different between males and females (p=0.005). Therefore it can be used to discriminate between sexes too.

A positive correlation existed between nasal height and the subject's height (r=0.330, p=0.04), as well as between the subject's weight and S1 (r=0.347, p=0.03), S2/ r= 0.431, p= 0.009/, S1+S2/r= 0.379, p= 0.017/, V1/r= 0.406,p= 0.01/, V2/r= 0.362,p= 0.023/ andV1+V2/r= 0.403,p= 0.011/.

Conclusion

The creation of three-dimensional models is necessary for different clinical and experimental purposes.

In plastic and maxillofacial surgery they are important for the correction of hard and soft tissues in malformations or after trauma.

They may also be useful in the diagnosis of genetic and psychiatric disorders.

In forensic anthropology these models may have various uses – for facial reconstruction, the descriptive construction of a "portrait" or as an identification aid.

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