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REVIEW ARTICLE

Classification of Nasal Index in Koreans According to Sex

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Background: The nose is located at the center of the face, and it is possible to determine race, sex, and the like. Research using the nasal index (NI) classification method to classify the shape of the nose is currently in progress. However, domestic research is required as most research is being conducted abroad. In this study, we used a 3D program to confirm the ratio of the nose shape of Koreans.

Methods: One hundred patients (50 males and 50 females) in their 20s were evaluated (IRB approval no. DKUDH IRB 2020-01-007). Cone beam computed tomography was performed using the Mimics ver. 22 (Materialise Co., Leuven, Belgium) 3D program to model the patient's skull and soft tissues into three views: coronal, sagittal, and frontal. To confirm the ratio of measurement metrics, analysis was performed using the SPSS ver. 23.0 (IBM Co., Armonk, NY, USA) program.

Results: Ten leptorrhine (long and narrow) type, 76 mesorrhine (moderate shape) type, and 14 platyrrhine (broad and short) type noses were observed. In addition, as a result of sex comparison, five males had the leptorrhine (long and narrow) type, 40 mesorrhine (moderate shape), and five platyrrhine (broad and short) types. For females, five patients had the leptorrhine (long and narrow) type, 36 patients had the mesorrhine (moderate shape) type, and nine patients had the platyrrhine (broad and short) type.

Conclusion: This study will be helpful when performing nose-related surgeries and procedures in clinical practice and for similar studies in the future.

Key Words: Asian people, Cone beam computed tomography, Koera, Nasal, Nose

Introduction

1. Background

Facial contouring is a field of interest in anatomy, anthropology, plastic surgery, and artists, and is now an essential part of forensic science due to individual identification[1]. In particular, facial features are affected by factors such as race, age, and culture[2]. The nose is located at the center of the face[3,4] and can determine race and sex[5].

Research using the nasal index (NI) classification method to classify the shape of the nose is currently in progress. In the NI classification method, four nose shapes are classified: leptorrhine (long and narrow nose), mesorrhine (medium nose), and platyrrhine (broad nose)[6,7]. In the past, NI was used in forensic medicine to evaluate remains[8], but now it is used in various clinical surgeries[5,9]. Therefore, the shape of the nose is important in modern society. However, domestic research is needed as most research is being conducted abroad[1-6,9-15].

In addition, in most previous studies, patients were actually measured and classified[1-6,9-15]. However, when the actual measurement is performed on the patient, it may be difficult to measure at an accurate point as the soft tissue is measured. Therefore, studies using cone beam computed tomography (CBCT), which can check bone and soft tissue at once, is needed.

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2. Objectives

In this study, after 3D modeling of the skull using a 3D program, the goal is to confirm the ratio of the nose shape of Koreans through measurement and evaluation for NI classification.

Materials and Methods

1. Ethics statement

The CBCT data of this study were retrospectively analyzed and proceeded after IRB approval at the Dankook University Dental Hospital.

2. Study design

1) Cone beam computed tomography data

All radiographs were performed by the same technician, and the Frontkfort Horizontal Plane (FH Plane) was taken perpendicular to the floor to reduce the difference in skull size for each patient. Imaging was performed after matching the sagittal midline of the face with CBCT (Alphard 3030; Asahi, Kyoto, Japan). The shooting conditions were a gantry angle of 0°, 120 kV, and auto mA. CBCT Sanning was slice increment, 0.39 mm; slice thickness, 0.39 mm; slice pitch, 3; scanning time, 4 seconds; matrix, proceeded with an image scale of 512×512 px. All CBCT data were then provided in Digital Imaging and Communications in Medicine (DICOM) format.

2) 3D image production

The provided DICOM was modeled using Mimics ver.22 (Materialise Co., Leuven, Belgium) 3D program to model the patient's skull and soft tissues into three views: coronal, sagittal, and frontal (Fig. 1). To extract soft tissue in 3D, Hounsfield unit (HU) was set to a minimum of 507 HU, a maximum of 3,071 HU, and masking was performed. The produced data was converted into a stereolithography (STL) file using the calculate part function. The skull and soft tissues converted to STL were measured for each item through the distance function.

3) Measurements

Measurements for all items were done based on the highest point after horizontally adjusting the Frankfort horizontal line. In addition, all measurements were evaluated after calculating the average value after measuring three

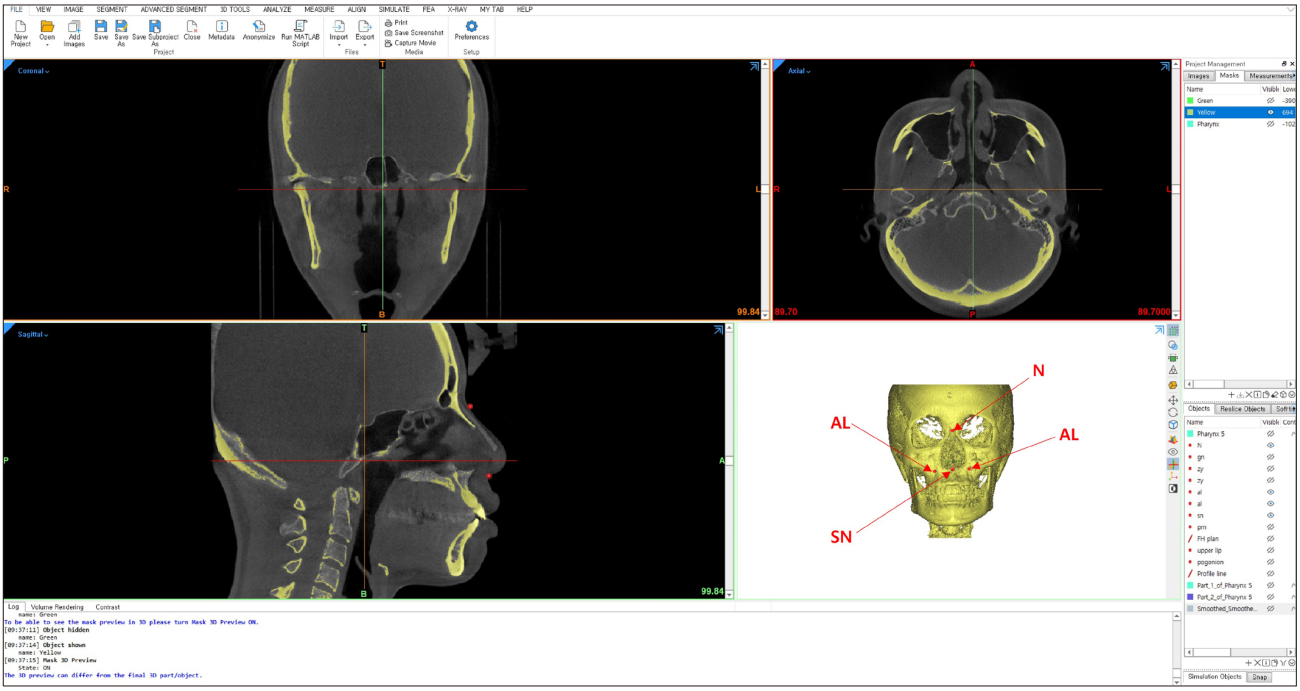

Fig. 1. Mimics Software (ver.22; Materialise Co, Leuven, Belgium). N: nasion, SN: subnasale, AL: alaria.

times. In addition, the reliability of the measured data (Cronbach's α=0.623) was confirmed through reliability analysis. The classification was performed by substituting into the formula according to the NI classification method. The measurement items and formula are as follows:

(1) Measurement metrics

The measurement metrics were the height and width of the nose (Table 1, Fig. 2).

(2) Measurement formula

Based on the above measured values, NI classification was performed through the formula below.

$$Nasal\ index\ (NI) = \frac{Nasal\ width\ (NW)}{Nasal\ height\ (NH)} \times 100$$

3. Sample size

This study was conducted on participants in their 20s with relatively less skin aging, as measurements were conducted on soft tissues. Therefore, CBCT data of 100 patients (50 males and 50 females) in their 20s who visited the Dankook University Dental Hospital were provided by the Department of Orthodontics. In addition, the number of study participants was calculated through the G-power ver. 3.1 (HHU, England) program.

Table 1. Nasal Index Metrics

Parameter	Definition
Nasal width (al-al)	Distance between Alaria (al)
Nasal height (n-sn)	Distance between N (nasion) and SN (subnasale)

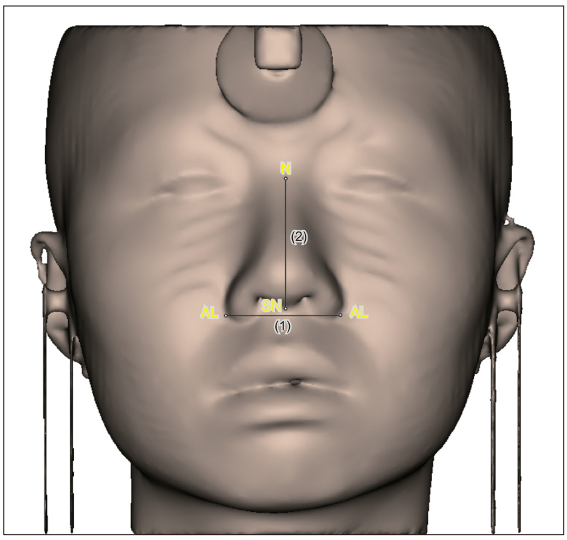

Fig. 2. Measurement Parameters of nasal index. (1) Nasal width is the Distance between Alaria (AL); (2) Nasal height is the Distance between nasion (N) and subnasale (SN).

4. Statistical methods

To confirm the ratio of measurement metrics, analysis was performed using the SPSS ver. 23.0 (IBM Co., Armonk, NY, USA) program. In addition, a cross-analysis was conducted to confirm the ratio of NI categories between sexes. A t-test was conducted to determine the mean difference in NI according to sex. All statistics were performed with a post hoc test set at 95% confidence interval and significance level at 0.05.

Results

1. Nasal index ratio

On evaluating the nose ratio, 10 patients had a leptorrhine (long and narrow) type with an NI of 55%～69.9%, 76 had a mesorrhine (moderate shape) type with an NI of 70%～84.9%, and 14 had a platyrrhine (broad and short) type with an NI of 85%～99.9%. However, hyperleptorrhine (very narrow) and hyperlatyrrhine (very broad/wide) were not observed (Table 2).

2. Comparison of nasal index averages by gender

On comparing the average NI by sex, it was confirmed that the average for males was 76.16 and for females was 77.84, which was higher for females on average. In addition, it was confirmed that both sexes had an average mesorrhine (moderate shape) shape. However, no statistically significant results were confirmed ($p > 0.05$) (Table 3).

Table 2. Nasal Index (NI) Classification

Nasal type	Range of NI (%)	Number
Leptorrhine (long and narrow)	55～69.9	10
Mesorrhine (moderate shape)	70～84.9	76
Platyrrhine (broad and short)	85～99.9	14

3. Nasal index ratio comparison between sex

On evaluating the nose ratio, five males had a leptorrhine (long and narrow) type with an NI of 55%～69.9%, 40 had a mesorrhine (moderate shape) type with an NI of 70%～84.9%, and five had a platyrrhine (broad and short) type with an NI of 85%～99.9%. In females, five had a leptorrhine (long and narrow) type with an NI of 55%～69.9%, 36 had a mesorrhine (moderate shape) type with an NI of 70%～84.9%, and nine had a platyrrhine (broad and short) type with an NI of 85%～99.9% (Table 4).

Discussion

1. Interpretation

The nose is fixed in the center of the face and is the most important structure for facial restoration[12]. Studies related to the nose are in progress, but most are foreign studies[1-6,9-15], and domestic studies are needed. This study aimed to confirm the ratio of Korean nose shape through 3D measurement.

2. Key results and comparison

The ratio of the nose of Koreans was observed in the leptorrhine, mesorrhine, and platyrrhine types, but the hyperleptorrhine and hyperlatyrrhine types were not observed. The leptorrhine type was observed in 10 patients, mesorrhine type in 76 patients, and platyrrhine type in 14 patients. It was observed that Koreans have a high proportion of the mesorrhine type. According to a study by Mohammed et al.[11], leptorrhine, mesorrhine, and platyrrhine types were observed in Adonis, Nigeria, and a high proportion of mesorrhine was reported, similar to the present study. However, according to Ray et al.[12], Lebanese, Dasmachus, Greeks, and Western Europeans reported that the leptorrhine type was more common. Consequently, it was found that the shape of the nose was different between the races. It appears that the shape and size of the nose are affected by the climate and environment, resulting in different shapes[13]. According to previous studies, the leptorrhine type was reported to be highly distributed in cold and dry climates, and the platyrrhine type was reported to be highly distributed in humid and warm climates[16,17]. The leptorrhine type appears to be highly distributed in Europe, which has a relatively dry climate, and the platyrrhine typ appears to be highly distributed in Africa, which has a relatively warm climate. It has also been reported that this phenomenon changes depending on the environment to ensure efficient breathing[17]. Leong and Eccles[13] According to research, it has been reported that if the nose is small and flat, it is easier to adapt to less turbulent airflow, and the resistance of the nasal airway is low, so it adapts better to hot and humid environments. Therefore, when judging the shape of the nose, race is important, but climate and

Table 3. Comparison of Nasal Index Averages by Sex

Sex	Mean (standard deviation)	p-value
Male (n=50)	76.16 (6.78)	0.230
Female (n=50)	77.84 (7.16)	

p-value was obtained by t-test.

Table 4. Nasal Index Analysis According to Sex

Participant	Nasal type			Entire	p-value
	Leptorrhine	Mesorrhine	Platyrrhine		
Sex					0.508
Male					
Number	5	40	5	50	
Expected frequency	5	38	7	50	
Female					
Number	5	36	9	50	
Expected frequency	5	38	7	50	
Entire					
Number	10	76	14	100	
Expected frequency	10	76	14	100	

environment are equally important.

As a result of evaluating the nose ratio, the leptorrhine type was found in the same ratio as 5 males and 5 females. For the mesorrhine type, there were 40 males and 36 females, and the proportion of males was smaller than that of females. As for the platyrrhine type, there were 5 males and 9 females, and there were more females than males. Therefore, it was observed that the proportion of the mesorrhine type was high in all sexes. Aung et al.[14] reported that both Chinese males and females had a high proportion of the mesorrhine type, similar to this study. According to a study by Ray et al.[12], Nepal and India also reported a high proportion of mesorrhine types, similar to this study. However, Turkey and Iran had a high proportion of the leptorrhine type, and Nigeria's Igbo region reported a high proportion of the platyrrhine type. Ryu et al.[15] reported that the shape of the skull, the nose, and the nostrils of the skull have a correlation. Therefore, Asians with similar facial shapes are judged to have a high proportion of mesorrhine types. As a result, it seems necessary to compare the shape of the nose with the shape of the face.

3. Suggestion

In this study, we observed the nose shape ratio of Koreans: leptorrhine (long and narrow) type, mesorrhine (moderate shape) type, and platyrrhine (broad and short) type. The nose is a structure that requires aesthetics because it is located in the center of the face. This is an area of great interest in various clinical trials. Accordingly, the data from this study comparing the shape of Koreans' noses is expected to be helpful in aesthetic research and clinical surgery. In particular, the nasal cavity, which determines the shape of the nose, is very important in the dental field. The nasal cavity is a breathing space; if breathing incorrectly, it can affect changes in the facial skeleton and cause malocclusion. Therefore, based on the results of this study, it is expected to be helpful in procedures and surgeries, such as orthodontic treatment and pediatric dentistry. This study will also be helpful for similar research in the future.

4. Limitations

This study had some limitations. It was considered that there was a slight difference according to the measurer even if the same mark point is used in the measurement of the 3D extracted nose. Accordingly, the average of the measured data was analyzed for reliability, and classification was performed after confirming the reliability of Cronbach's α=0.618. This way, we tried to improve the limitations while conducting the study, and more supplementary studies will be needed in the future.

Notes

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

This study was approved by the institutional review board of Dankook University (IRB approval no. DKUDH IRB 2020-01-007).

Author contributions

Conceptualization: Jeong-Hyun Lee. Data acquisition: Min-Gyu Park and Jeong-Hyun Lee. Formal analysis: Min-Gyu Park and Jeong-Hyun Lee. Supervision: Sung-Suk Bae and Jeong-Hyun Lee. Writing–original draft: Hee-Jeung Jee and Jeong-Hyun Lee. Writing–review & editing: Sung-Suk Bae and Jeong-Hyun Lee.

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Data availability

Raw data is provided at the request of the corresponding author for reasonable reason.

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