# Morphological and Morphometric Analysis of the Nasopalatine Canal Using CBCT: Influence of Age, Sex, and Dental Status

Beyzanur Büyük[1], Damla Soydan Çabuk[1], Hazal Duyan Yüksel[1], Burcu Evlice[1]

1 Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Çukurova University, Adana, Türkiye

## Abstract

**Aim:** The nasopalatine canal (NPC) is a crucial anatomical structure located in the anterior maxilla, exhibiting morphological and dimensional variations. These variations may influence dental implant placement and surgical planning. This study aims to evaluate the morphology and dimensions of the NPC using cone-beam computed tomography (CBCT) and to analyze its relationship with gender, age, and the presence of anterior teeth.

**Methods:** A total of 1023 patients' CBCT scans were retrospectively analyzed. NPC morphology was categorized into three types: single canal, parallel canals, and Y-shaped canal. The width and length of the NPC were measured. Chi-square, Kruskal-Wallis, and Mann-Whitney U tests were used for statistical analyses. The relationship between age and NPC dimensions was evaluated using Spearman's correlation coefficient.

**Results:** NPC morphology showed a statistically significant difference according to gender ($p = 0.047$). The Y-shaped canal was more prevalent in males, while the single canal type was more frequently observed in females. NPC length was significantly greater in males ($p < 0.001$) and in patients with anterior teeth ($p < 0.001$). However, no significant difference was found between NPC width and the presence of anterior teeth ($p > 0.05$).

**Conclusions:** This study highlights the anatomical variations and clinical significance of the NPC. Preoperative CBCT evaluation is essential for safer and more precise surgical procedures. Gender and dental status should be taken into consideration during implant planning in the anterior maxilla.

***Keywords:*** *Anatomical variations; cone-beam computed tomography; implant surgery; maxillary morphology; nasopalatine canal*

## 1. Introduction

The nasopalatine canal (NPC) lies in the anterior maxilla, typically in the midline and behind the maxillary central incisors. Its oral entrance, the incisive foramen (IF), is located beneath the incisive papilla. Superiorly, it opens into the nasal cavity through the nasal foramina on either side of the nasal septum. The canal contains the nasopalatine nerve and the terminal branch of the descending palatine artery, and shows considerable variation in form and size. On intraoral radiographs, it is usually seen between the roots of the central incisors[1].

Considering the potential surgical risks in the anterior maxilla, it is important to assess the nasopalatine canal's morphology and size before planning dental implant placement in this region[2]. Therefore, detailed radiological evaluation prior to surgery is of great importance. Cone-beam computed tomography (CBCT) is an effective imaging modality that provides high-resolution, three-dimensional visualization of the nasomaxillary complex[3,4]. It allows accurate assessment of the canal's shape, orientation, and spatial relationship to adjacent structures[3]. Such evaluation is critical to prevent complications such as hemorrhage, neurosensory disturbances, or implant failure[4]. Moreover, anatomical variations of the NPC may influence the outcomes of procedures such as bone grafting and alveolar ridge augmentation. It has been reported that wide or double-canal variants may complicate surgical access and overlap with osteotomy lines, thereby increasing the risk of postoperative paresthesia[4–6]. In this context, CBCT has been widely employed as a reliable imaging modality for evaluating the nasomaxillary complex, enabling detailed visualization and measurement of anatomical structures such as the nasopalatine canal. Several studies have successfully used CBCT to assess canal length, width, angulation, and the number of openings in diverse populations, supporting its utility in treatment planning within anatomically variable regions[7–9]. The aim of this study is to evaluate the morphological and morphometric characteristics of the nasopalatine canal using cone-beam computed tomography (CBCT), and to investigate their relationship with age, gender, and anterior tooth status.

## 2. Materials and Methods

The ethical approval of the study was obtained from Çukurova University Faculty of Medicine, Ethics Committee (2025-Decision No: 26).

*Corresponding Author: Beyzanur Büyük, buyukbeyza65@gmail.com,* *Received: 11.09.2025, Accepted: 03.02.2026, Available Online Date: 15.03.2026. https://doi.org/10.36516/jocass.1781642* 

CBCT scans were obtained from the Division of Dentomaxillofacial Radiology. In the present study, CBCT scans taken for various reasons between 2024 January and 2025 March were evaluated. Initially, a total of 1250 CBCT scans were obtained.

*Inclusion Criteria:*

- Patients aged 18 years and older, ensuring completion of craniofacial growth
- Presence of CBCT images in which the anatomical structure of the nasopalatine canal (NPC) in the maxillary central incisor region can be clearly evaluated
- Individuals representing different anterior dental statuses (dentate, partially edentulous, and completely edentulous), allowing evaluation of the association between NPC morphology and dental status

*Exclusion Criteria:*

- Congenital anomalies affecting the maxillofacial region (e.g., cleft palate)
- History of surgical intervention or presence of pathological formations in the region
- Systemic diseases known to affect bone metabolism (e.g., metabolic bone disorders) that could influence maxillary bone morphology
- CBCT scans with motion artifacts, insufficient image quality, or limited field of view preventing accurate identification and measurement of the nasopalatine canal

### *Image Analysis*

The imaging procedure was performed using a Planmeca ProMax® 3D Mid unit (Helsinki, Finland) with the following parameters: 90 kV tube voltage, 10 mA current, 27-second exposure time, and 0.4 mm voxel resolution. Image analyses were performed by two radiologists (XX, 9 years of experience; XX ,three years of experience) in a dark and quiet room using the Planmeca Romexis imaging software.

In the present study, the anatomical features of the nasopalatine canal (NPC) were evaluated using coronal CBCT images and classified into three types according to the criteria defined by Özçakır-Tomruk et al.[10]: (a) single canal, (b) two parallel canals, and (c) Y-shaped canal with one oral/palatal opening (incisive foramen) and two or more nasal openings (Figure 1).

Additionally, the dimensions of the NPC were measured using sagittal CBCT images, following a methodology similar to that described by Bornstein et al.[2] (Figure 2). Furthermore, the participants were categorized into four groups based on their edentulous status, according to the classification defined by Etoz et al.:[11].

- **Group 0:** Completely edentulous individuals
- **Group 1:** Both maxillary central incisors present
- **Group 2:** One maxillary central incisor missing
- **Group 3:** Both maxillary central incisors missing

### *Statistical Analysis*

Based on the data from a previous study by Etoz and Sisman (2014), the minimum required sample sizes were calculated for nasopalatine canal length, incisive foramen width, and the width of bifurcated nasal openings in Y-shaped canals, using a 95% power and a 5% significance level. The calculated minimum sample sizes were 57 (Effect Size: 0.68), 331 (Effect Size: 0.28), and 379 (Effect Size: 0.26), respectively. In the present study, all patients meeting the inclusion and exclusion criteria were screened to achieve the largest possible sample size, resulting in a total of 1,023 cases.

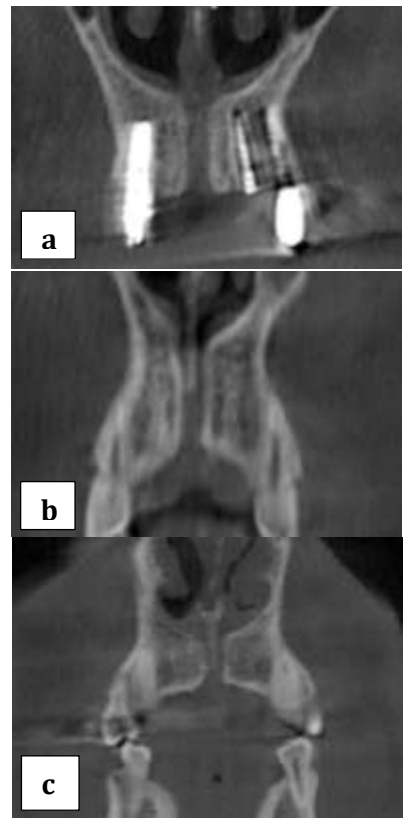


Figure 1

Representative coronal CBCT images demonstrating the three main morphologies of the nasopalatine canal (NPC): (a) Type A – Single canal; (b) Type B – Two parallel canals; (c) Type C – Y-shaped canal with bifurcated nasal openings.

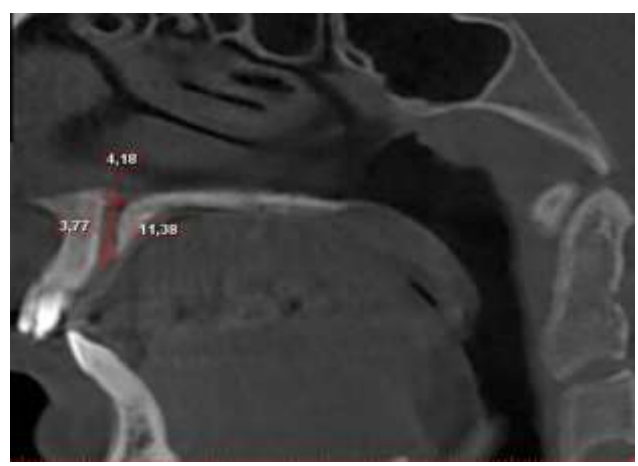


Figure 2

Sagittal CBCT image showing measurements of the nasopalatine canal (NPC). Canal length was measured from the nasal to oral openings (11.38 mm). Superior and inferior diameters were recorded as 4.18 mm and 3.77 mm, respectively. Measurements were performed using Planmeca Romexis software (voxel size: 0.4 mm).

Categorical data were presented as frequencies and percentages, while numerical data were expressed as mean ± standard deviation (SD) and median (min–max). The relationships between categorical variables were assessed using the chi-square test. When significant associations were found, Bonferroni correction was applied to adjust *p*-values for multiple comparisons. The normality of numerical data was evaluated using the Kolmogorov–Smirnov test. For comparisons between two groups, the Mann–Whitney *U* test was employed, and for comparisons among three or more groups, the Kruskal–Wallis test was used. If the Kruskal–Wallis test indicated significant differences, the Dunn–Bonferroni post hoc test was applied. Correlations between age and numerical variables were assessed using Spearman's correlation coefficient. Interobserver reliability was evaluated by calculating the intraclass correlation coefficient (ICC). A p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 20.0 (IBM Corp., Chicago, IL, USA).

**Table 1**

NPC Morphology by Gender, Age, and Anterior Teeth

| Morphology | Gender‡ | | | Age† | | Anterior teeth‡ | | |
|---|---|---|---|---|---|---|---|---|
| | Female | Male | p | | p | Present | Absent | p |
| | N, % | N, % | | mean±sd, md (min-mx) | | N, % | N, % | |
| a | 253 | 289 | | 45.88±15.71 | | 121a | 421b | |
| | %54.2 | %52 | | 48(18-78) | | %46.9 | %55 | |
| b | 88 | 82 | 0.047* | 45.39±16.13 | 0.735 | 49 | 121 | 0.077 |
| | %18.8 | %14.7 | | 48(18-80) | | %19 | %15.8 | |
| c | 126a | 185 | | 46.5±15.07 | | 88 | 223 | |
| | %27 | %33.3 | | 46(18-82) | | %34.1 | %29.2 | |
| Total | 467 | 556 | | 45.99±15.58 | | 258 | 765 | |
| | %100 | %100 | | 48(18-82) | | %100 | %100 | |

*Data are shown as mean ± standard deviation, median (minimum–maximum) and frequencies (column %).*
*a:Single canal*
*b:Two parallel canals*
*c:Y-shaped canal with bifurcated nasal openings.*
*† Kruskal Wallis test.*
*‡ Chi-square test.*
*[a, b] Different superscript letters within the same column indicate statistically significant differences between groups based on Bonferroni-corrected post-hoc tests (p < 0.05).*
**: p < 0.05*

**Table 2**

Comparison of NPC Dimensions by Gender, Age, and Anterior Teeth Presence

| | Gender† | | | Age | | Anterior teeth† | | |
|---|---|---|---|---|---|---|---|---|
| | Female mean±sd md(min-mx) | Male mean±sd md(min-mx) | p | r‡ | p | Present mean±sd md(min-mx) | Absent mean±sd md(min-mx) | p |
| Upper Diameter | 2.22±0.84 | 2.41±1.12 | 0.034* | -0.087 | 0.006* | 2.32±1.01 | 2.32±1 | 0.831 |
| | 2(0.57-4.87) | 2.04(0.8-6.71) | | | | 2.04(0.57-6.71) | 2.04(0.8-5.26) | |
| Lower Diameter | 5.43±2.06 | 5.06±1.96 | 0.014* | -0.225 | <0.001** | 5.53±2.03 | 4.34±1.7 | <0.001** |
| | 5.26(1.44-11.76) | 5.01(0.8-9.94) | | | | 5.37(1.2-11.76) | 4.31(0.8-8.44) | |
| Length | 10.83±3.12 | 12.05±3.51 | <0.001** | -0.046 | 0.142 | 11.83±3.35 | 10.48±3.3 | <0.001** |
| | 10.98(2.91-19.35) | 11.82(2.88-23.88) | | | | 11.66(2.88-23.88) | 11.08(2.91-19.35) | |

*Data are shown as mean±standard deviation, median (minimum-maximum) and frequencies (column %).*
*† Mann–Whitney U test.*
*‡ Spearman correlation coefficient.*
**: p < 0.05 ,**: p < 0.001*

**Table 3**

Age and Gender by Anterior Teeth Status

| | Anterior teeth | | |
|---|---|---|---|
| | Present<br>mean±sd<br>md(min-mx) | Absent<br>mean±sd<br>md(min-mx) | p |
| Age† | 41.68±14.2<br>42(15-75) | 58.77±12.13<br>60.5(18-82) | <0.001** |
| | Anterior teeth | | |
| | Present | Absent | |
| Gender‡ | | | |
| Female | 375<br>%49 | 92<br>%35.7 | <0.001** |
| Male | 390<br>%51 | 166<br>%64.3 | |

*Data are shown as mean±standard deviation, median (minimum-maximum) and frequencies (column %).*
*† Mann–Whitney U test.*
*‡ Chi-square test.*
***: p < 0.001*

## 3. Results

Of the total 1023 individuals included in the study, 467 were female (45.7%) and 556 were male (54.3%). The mean age of the participants was 45.99 ± 15.58 (range: 18–82). The morphology of the nasopalatine canal was classified into three types based on CBCT sections in the coronal plane: Type A (single canal), Type B (two parallel canals), and Type C (Y-shaped canal).

The most frequently observed morphology was Type A (single canal), which was identified in 53% of all individuals. Type C (Y-shaped canal) was observed in 30.4% of the cases, while Type B (parallel canals) was the least common, seen in 16.6% of the individuals. When this distribution was analyzed by gender, Type C morphology was found to be significantly more frequent in male individuals compared to females ($p$ = 0.047) (**Table 1**). Although Type B (two parallel canals) morphology was observed at a higher rate in female individuals, this difference was not statistically significant.

No significant difference was found between age and canal morphology ($p$ = 0.735). The mean ages were similar across all groups (Type A: 45.88 ± 15.71, Type B: 45.39 ± 16.13, Type C: 46.5 ± 15.07) (**Table 1**).

Although the overall association between anterior tooth status and canal morphology did not reach statistical significance ($p$ = 0.077), a higher frequency of Type A morphology was observed in edentulous individuals. However, this trend did not reach statistical significance, and should therefore be interpreted with caution. **(Table 1)**

The upper diameter of the nasopalatine canal was found to be significantly wider in males (2.41 ± 1.12 mm) compared to females (2.22 ± 0.84 mm) ($p$ = 0.034). In contrast, the lower diameter was significantly greater in females (5.43 ± 2.06 mm) than in males (5.06 ± 1.96 mm) ($p$ = 0.014). The canal length was also notably greater in males (12.05 ± 3.51 mm) compared to females (10.83 ± 3.12 mm), and this difference was found to be highly significant ($p$ < 0.001) (**Table 2**).

**Table 4**

Comparison of Age and NPC Dimensions by Edentulism Status

| Edentulism | n | Age | | Upper Diameter | | Lower Diameter | | Length | |
|---|---|---|---|---|---|---|---|---|---|
| | | mean±sd<br>md(min-mx) | p | mean±sd<br>md(min-mx) | p | mean±sd<br>md(min-mx) | p | mean±sd<br>md(min-mx) | p |
| Group 0 | 121 | 64.07±8.8a,c<br>64(42-82) | | 2.45±1.15<br>2.04(0.8-5.26) | | 4.27±1.6a<br>4(1.6-7.35) | <0.001** | 10.23±3.93a,b<br>10.93(2.91-19.35) | |
| Group 1 | 669 | 39.25±13.33b,c<br>39(15-75) | <0.001** | 2.32±1.02<br>2.04(0.57-6.71) | 0.468 | 5.63±2.03b,c<br>5.44(1.2-11.76) | | 11.84±3.36c<br>11.76(2.88-23.88) | <0.001** |
| Group 2 | 96 | 58.63±6.23<br>58(43-73) | | 2.31±0.85<br>2.04(0.8-3.69) | | 4.72±1.8<br>4.68(1.6-9.12) | | 11.7±3.25<br>11.45(4.33-16.82) | |
| Group 3 | 137 | 54.09±12.75<br>55(18-77) | | 2.2±0.84<br>2(0.8-5.22) | | 4.4±1.78<br>2(0.8-8.44) | | 10.7±2.61<br>11.26(4.42-15.04) | |

*Data are shown as mean±standard deviation, median (minimum-maximum) and frequencies (column %).*
*Group 0: Completely edentulous individuals, Group 1: Both maxillary central incisors present, Group 2: One maxillary central incisor missing Group 3: Both maxillary central incisors missing, Kruskal–Wallis test was used.*
*a: Statistically significant difference compared to the group with both central incisors present (Dunn–Bonferroni post hoc test, p < 0.05)*
*b: Statistically significant difference compared to the group with one central incisor present (Dunn–Bonferroni post hoc test, p < 0.05)*
*c: Statistically significant difference compared to the group with no central incisors (Dunn–Bonferroni post hoc test, p < 0.05)*
**: p < 0.05 *, **: p < 0.001*

In Spearman correlation analyses between the dimensions of the nasopalatine canal and age, statistically significant but very weak negative correlations were found between age and upper diameter (r = -0.087, $p$ = 0.006), and lower diameter (r = -0.225, $p$ < 0.001). No significant relationship was found between canal length and age (r = -0.046, $p$ = 0.142) (**Table 2**).

In comparisons based on the presence of anterior teeth, both the lower diameter and canal length were found to be significantly greater in individuals with anterior teeth ($p$ < 0.001 and $p$ < 0.001, respectively) (**Table 2**). In contrast, no significant difference was found regarding the upper diameter based on the presence of anterior teeth ($p$ = 0.831).

The mean age of individuals with anterior teeth was 41.68±14.20 years, whereas this average was determined as 58.77±12.13 in individuals without anterior teeth. The median ages were 42 and 60.5, respectively, and this difference was found to be statistically significant ($p$<0.001). This finding indicates that anterior tooth loss increases with age (**Table 3**).

When evaluated by gender, anterior tooth loss was significantly more prevalent in males than in females ($p$ < 0.001) (**Table 3**).

Significant differences in age and nasopalatine canal dimensions were observed among the edentulism groups (**Table 4**). The mean age of completely edentulous individuals was 64.07±8.80 years, which was significantly higher than that of individuals with all teeth (39.25±13.33 years) and those with only one central incisor (58.63±6.23 years) ($p$<0.001).

Regarding lower diameter measurements, the mean value in completely edentulous individuals was 4.27±1.60 mm, which was significantly lower than in individuals with all anterior teeth (5.63±2.03 mm) ($p$<0.001). Canal length was also significantly shorter in completely edentulous individuals (10.23±3.93 mm) compared to those with central incisors (11.84 ± 3.36 mm) ($p$<0.001) (**Table 4**).

These findings suggest that edentulism particularly affects the inferior diameter, and canal length of the nasopalatine canal. These changes may also be partly related to age-related bone alterations.

## 4. Discussion

Morphometric variations of the NPC are examined according to gender, age, anterior teeth presence, and edentulism, and are discussed in the context of previous studies. The results suggest that variations in canal dimensions may be associated with factors such as gender, and dental status. In the present study, it was investigated to evaluate the morphology and dimensions of the NPC using cone-beam computed tomography (CBCT) and to analyze its relationship with gender, age, and the presence of anterior teeth.

Evaluation of the nasopalatine canal morphology in the coronal plane revealed that the most common type was Type A (single canal), followed by Type C (Y-shaped), and Type B (parallel canals). Among the groups, Type C morphology was significantly more frequent in males (p = 0.047) (Table 1). These findings are partly consistent with previous studies. For instance, Bornstein et al. reported that the most frequent morphologies were the single canal and Y-shaped types, whereas Gönül et al. found the Y-shaped canal to be more common in male individuals within a Turkish population[2,12]. These results support the observed gender-related variation in Type C morphology, although the predominance of Type A remains consistent across studies.

In the present study, Type B morphology was more frequently observed in females; however, this difference was not statistically significant. While some studies such as Khojastepour et al. have reported similar gender-related distributions, no consistent or statistically significant pattern of Type B prevalence related to gender has been clearly established[13].

The length of the nasopalatine canal was found to be significantly greater in male individuals compared to females (p < 0.001). The upper diameter was also wider in males, and although this difference was statistically significant, it was relatively limited (p = 0.034). In contrast, the lower diameter was significantly wider in females than in males (p = 0.014). These findings suggest that gender may influence certain morphometric features of the nasopalatine canal.

Interestingly, in contrast to the findings of Shalu Rai et al. who reported significantly greater canal length and palatal diameter in male individuals, the present study found that the inferior diameter was significantly greater in females (p = 0.014). Although the terms differ, the palatal diameter in their study corresponds anatomically to the inferior diameter measured in the current research. This difference may be attributed to differences in sample size, ethnic composition, or measurement protocols used in the respective studies[14]. Similarly, Bornstein et al. observed that male individuals tend to exhibit wider nasopalatine canal dimensions, which has been associated with the generally thicker maxillary bone structure in males[2]. These variations highlight the need for population-specific data when evaluating nasopalatine canal morphology for clinical applications.

However, studies evaluating the morphometric characteristics of the nasopalatine canal have reported varying results depending on the population and methodology. While some research focused on canal length and diameter, gender-specific analyses have not been consistently included or have yielded inconclusive results. For instance, Mardinger et al. (2008) focused on canal diameter changes in relation to ridge resorption and implant planning, without emphasizing gender-based morphometric comparisons[15].

Although statistically significant, the negative correlations between age and the superior and inferior diameters of the nasopalatine canal were weak (r = -0.087 and r = -0.225, respectively), suggesting that the observed age-related changes in canal dimensions are likely not clinically meaningful. No significant correlation was found between canal length and age.

Similarly, Tözüm et al. reported that the length and diameter of the nasopalatine canal were significantly greater in male individuals compared to females. However, no significant correlation was found between age and the dimensions of the nasopalatine canal[16]. Liang et al. reported a statistically significant positive correlation between age and canal diameter, suggesting that the increase in canal size with age might be more closely related to edentulism and subsequent alveolar bone resorption rather than age itself[3]. In contrast, the present study found a weak but statistically significant negative correlation between age and canal diameter, with no significant association observed for canal length. This discrepancy may reflect differences in population characteristics, imaging modality, or the inclusion of edentulous versus dentate individuals in the sample.

In some studies, no significant relationship has been reported between age and nasopalatine canal measurements. For example, Khojastepour et al. found statistically significant but very weak correlations between age and certain canal parameters and concluded that the overall impact of age on canal morphology was limited. This finding was attributed to interindividual anatomical variations[13]. In this context, although age may influence the morphology of the nasopalatine canal, this effect appears to be generally weak, and considering individual anatomical differences seems to be more important in clinical evaluations.

When the relationship between the presence of anterior teeth

and demographic factors was evaluated, individuals with anterior teeth were found to be significantly younger ($p<0.001$), and the proportion of males was higher among edentulous individuals ($p<0.001$). These findings suggest that anterior tooth loss may be an age-related process and may occur more frequently in male individuals. However, the literature generally indicates that edentulism is more prevalent among females. For instance, Tyrovolas et al. in their global analysis of individuals aged ≥50 years, reported that the likelihood of edentulism was significantly higher in females. Similarly, Park et al. observed a higher prevalence of edentulism among elderly women compared to men, although the difference was not statistically significant. Nonetheless, the higher prevalence of edentulism among males in the present study may reflect population-specific characteristics, including differences in socioeconomic background, lifestyle factors, or healthcare accessibility[17],[18].

Completely edentulous individuals exhibit significantly smaller inferior diameter and canal length compared to those with all anterior teeth present ($p<0.001$). However, no significant difference was observed between the two groups in terms of superior diameter. This finding suggests that the presence of anterior teeth may influence canal morphology, particularly affecting the inferior diameter and length measurements.

Similarly, Tözüm et al. also reported that canal length was significantly reduced in completely edentulous individuals. This was thought to be related to alveolar bone resorption in the anterior region[16].

On the other hand, some studies have reported that the relationship between anterior tooth loss and nasopalatine canal dimensions is not consistent. For instance, Liang et al. found no significant difference in canal diameter between dentate and edentulous individuals. However, canal length was significantly shorter in the edentulous group, suggesting that anterior tooth loss may particularly affect the vertical dimension of the canal. Still, the authors noted considerable interindividual variation and emphasized that tooth loss alone may not fully account for changes in canal dimensions[3].

In light of these findings, it can be suggested that the presence of anterior teeth may affect nasopalatine canal measurements; however, this effect should be evaluated in conjunction with individual anatomical factors and variables such as age.

In completely edentulous individuals, no statistically significant difference was observed in the superior diameter of the nasopalatine canal compared to dentate individuals ($p = 0.468$). Additionally, the significantly higher mean age in completely edentulous individuals suggests that edentulism, as an age-related condition, may influence canal morphology.

Therefore, factors such as age, gender, and dental status should be taken into account when evaluating the nasopalatine canal; however, it should be remembered that individual anatomical differences remain the primary determinant in clinical planning.

### Limitations

The present study has several limitations. First, although the sample size was adequate, the retrospective and cross-sectional design does not allow for clear identification of cause-and-effect relationships. Second, the absence of data regarding the duration of edentulism and the timing of anterior tooth loss limited a more detailed evaluation of their impact on canal morphology. In addition, the inclusion of individuals from a single geographic and ethnic background may reduce the generalizability of the findings to other populations.

Another limitation is that the evaluation was based solely on radiological findings, without clinical or histological correlation. Finally, although CBCT provides high-resolution images, factors such as voxel size, image quality, patient positioning, and interobserver variability may affect measurement accuracy (19–21). While interobserver reliability was assessed using intraclass correlation coefficients, minor measurement discrepancies cannot be completely excluded. Future prospective, multicenter studies incorporating clinical parameters and longitudinal follow-up may provide more comprehensive insight into the influence of age, sex, and dental status on nasopalatine canal morphology.

## 5. Conclusion

The findings of the present study demonstrate that edentulism significantly affects the inferior diameter, and length of the nasopalatine canal. Morphological variations in this structure are also influenced by factors such as age, gender, and anterior tooth status. Given the clinical importance of the nasopalatine canal in procedures such as implant placement, surgical interventions, and local anesthesia in the anterior maxilla, these results emphasize the necessity of individualized anatomical assessment. Preoperative evaluation using CBCT plays a critical role in identifying anatomical variations and improving surgical safety. Ultimately, recognizing these anatomical differences may help clinicians optimize treatment planning and enhance outcomes, especially in anatomically complex or compromised cases.

## Statement of ethics

The ethical approval of the study was obtained from Çukurova University Faculty of Medicine, Ethics Committee (2025-Decision No: 26).

## genAI

No artificial intelligence-based tools or generative AI technologies were used in this study. The entire content of the manuscript was originally prepared, reviewed, and approved by both authors.

## Funding

None.

## Conflict of interest statement

The authors declare that they have no conflict of interest.

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

## Author contributions

Concept and Design: DSÇ, BE; Data Collection: DSÇ; Analysis and Interpretation: HDY ; Literature Search: BB, DSÇ, BE; Writing: BB, HDY

## References

1. Jacobs R, Lambrichts I, Liang X, Martens W, Mraiwa N, Adriaensens P, et al. Neurovascularization of the anterior jawbones revisited using high-resolution magnetic resonance imaging. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;103(5):683-93.Crossref

2.Bornstein MM, Balsiger R, Sendi P, Von Arx T. Morphology of the nasopalatine canal and dental implant surgery: a radiographic analysis of 100 consecutive patients using limited cone-beam computed tomography. Clin Oral Implants Res. 2011;22(3):295-301.Crossref

3.Liang X, Jacobs R, Martens W, Hu Y, Adriaensens P, Quirynen M, et al. Macro- and micro-anatomical, histological and computed tomography scan characterization of the nasopalatine canal. J Clin Periodontol.

2009;36(7):598-603.
Crossref
4. Mraiwa N, Jacobs R, Van Cleynenbreugel J, Sanderink G, Schutyser F, Suetens P, et al. The nasopalatine canal revisited using 2D and 3D CT imaging. Dentomaxillofac Radiol. 2004;33(6):396-402.Crossref
5. Verardi S, Pastagia J. Obliteration of the nasopalatine canal in conjunction with horizontal ridge augmentation. Compend Contin Educ Dent. 2012 Feb;33(2):116-22.
6. Artzi Z, Nemcovsky CE, Bitlitum I, Segal P. Displacement of the incisive foramen in conjunction with implant placement in the anterior maxilla without jeopardizing vitality of nasopalatine nerve and vessels: a novel surgical approach. Clin Oral Implants Res. 2000;11(5):505-10. Crossref
7. Akkoca F, Yeşilova E. Assessment of the naso-maxilla and related dentoalveolar region with cone beam computed tomography. Int J Oral Maxillofac Implants. 2023;38(5):885-96.Crossref
8. López Jornet P, Boix P, Sánchez Pérez A, Boracchia A. Morphological characterization of the anterior palatine region using cone beam computed tomography. Clin Implant Dent Relat Res. 2015 Oct;17(Suppl 2):e459-e464. Crossref
9. Bahşi I, Orhan M, Kervancıoğlu P, Yalçın ED, Aktan AM, et al. Anatomical evaluation of nasopalatine canal on cone beam computed tomography images. Folia Morphol (Warsz). 2019;78(1):153-62.Crossref
10. Özçakır-Tomruk C, Dölekoğlu S, Özkurt-Kayahan Z, İlgüy D. Evaluation of morphology of the nasopalatine canal using cone-beam computed tomography in a subgroup of Turkish adult population. Surg Radiol Anat. 2016;38:65-70.
Crossref
11. Etoz M, Sisman Y. Evaluation of the nasopalatine canal and variations with cone-beam computed tomography. Surg Radiol Anat. 2014;36:805-12. Crossref
12. Gönül Y, Bucak A, Atalay Y, Beker-Acay M, Çalişkan A, Sakarya G, et al. MDCT evaluation of nasopalatine canal morphometry and variations: an analysis of 100 patients. Diagn Interv Imaging. 2016;97(11):1165-72. Crossref
13. Khojastepour L, Haghnegahdar A, Keshtkar M. Morphology and dimensions of nasopalatine canal: a radiographic analysis using cone beam computed tomography. J Dent (Shiraz). 2017;18(4):244-9.
14. Rai S, Misra D, Misra A, Khatri M, Kidwai S, Bisla S, et al. Significance of morphometric and anatomic variations of nasopalatine canal on cone-beam computed tomography in anterior functional zone: a retrospective study. Ann Maxillofac Surg. 2021;11(1):108-14. Crossref
15. Mardinger O, Namani-Sadan N, Chaushu G, Schwartz-Arad D. Morphologic changes of the nasopalatine canal related to dental implantation: a radiologic study in different degrees of absorbed maxillae. J Periodontol. 2008;79(9):1659-62.Crossref
16. Tözüm TF, Güncü GN, Yıldırım YD, Yılmaz HG, Galindo-Moreno P, Velasco-Torres M, et al. Evaluation of maxillary incisive canal characteristics related to dental implant treatment with computerized tomography: a clinical multicenter study. J Periodontol. 2012 Mar;83(3):337-43. Crossref
17. Tyrovolas S, Koyanagi A, Panagiotakos DB, Haro JM, Kassebaum NJ, Chrepa V, et al. Population prevalence of edentulism and its association with depression and self-rated health. Sci Rep. 2016;6:37083.Crossref
18. Park HA, Shin SH, Ryu JI. Edentulous disparities among geriatric population according to the sexual difference in South Korea: a nationwide population-based study. Sci Rep. 2023;13(1):7854.Crossref
19. Miracle AC, Mukherji SK. Conebeam CT of the head and neck, part 1: physical principles. AJNR Am J Neuroradiol. 2009;30(6):1088-95.Crossref
20. Spin-Neto R, Gotfredsen E, Wenzel A. Impact of voxel size variation on CBCT-based diagnostic outcome in dentistry: a systematic review. J Digit Imaging. 2013;26(4):813-20.Crossref
21. Wolf TG, Fischer F, Schulze RKW. Correlation of objective image quality and working length measurements in different CBCT machines: An ex vivo study. Sci Rep. 2020;10(1):19414. Crossref