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CONE-BEAM COMPUTED TOMOGRAPHY ASSESSMENT OF THE NASOPALATINE CANAL DIMENSIONS CONSIDERING THEIR RELATIONSHIP WITH DENTAL IMPLANT PLACEMENT IN A SAMPLE OF YEMENI POPULATION

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ABSTRACT

Objective: To radiographically assess the anatomical variations and dimensions of the nasopalatine canal (NPC) using cone-beam computed tomography (CBCT) and evaluate their relationship with gender, age, and dental condition in a Yemeni population to guide safe dental implant placement in the anterior maxilla.

Materials and Methods: A retrospective cross-sectional study was conducted on 335 CBCT scans of adult Yemeni patients (≥18 years). NPC length and diameters at the incisive and nasal foramina were measured. Comparisons were performed according to gender, age (18–45 vs. >45 years), dental condition (dentate vs. edentulous), and number of missing maxillary central incisors. Statistical analyses included normality testing, independent t-tests/Mann–Whitney tests, chi-square tests, and intraclass correlation coefficients (ICC) for reliability.

Results: The mean NPC length was 9.93 ± 2.30 mm. Mean NPC diameters at the incisive and nasal foramina were 3.03 ± 0.80 mm and 3.16 ± 1.21 mm, respectively. NPC length and both foraminal diameters were significantly greater in males than females ($p<0.05$). The incisive foramen diameter was significantly larger in older (>45 years) and edentulous patients ($p<0.05$), whereas nasal foramen diameter showed no significant association with age or dental condition. Patients missing one central incisor demonstrated a significantly longer NPC compared with those missing both.

Conclusion: Considerable variability exists in NPC dimensions in the Yemeni population, influenced mainly by gender and, to a lesser extent, age and dental status. Preoperative CBCT evaluation of the NPC is essential to minimize complications during implant placement in the anterior maxilla.

Keywords**:** Nasopalatine canal, CBCT, Yemeni population, dental implants, anterior maxilla

INTRODUCTION

The nasopalatine canal (NPC) is called the incisive canal since the NPC is located palatal to the central incisors and it has two openings: the incisive foramen, which is located underneath the incisive papilla, and the nasal opening or foramina of Stenson [1]. The most recent studies assessing NPC dimensions and variations used CBCT technology considering the effects of sex, age, and the presence or absence of maxillary central incisors on NPC morphological and dimensional characteristics [2].

The close proximity of the maxillary incisive canal with the anterior incisors area affects one's ability to place implants in ideal position. To avoid causing complications, variations in its dimensions should be clearly evaluated [5].

Based on the aforementioned issues, this study was conducted to radiographically assess the anatomical variations of the NPC a using CBCT for the purpose of providing dental implant treatment on a group of Yemeni population.

MATERIALS AND METHODS

An analytical retrospective cross-sectional study was included 1000 maxillary arch CBCT images of patients who were referred to a private radiology center at Sana'a city, Yemen during the period from January 2017 to December 2019. All participants were ≥ 18 years, not have (pathological lesion, impacted teeth or

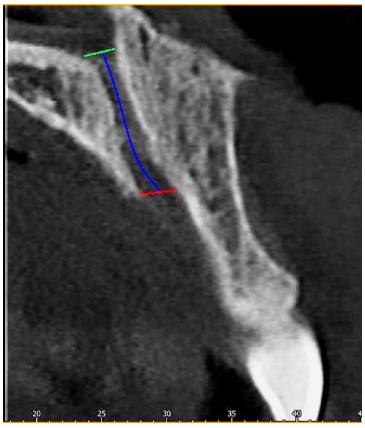
fracture in anterior maxillary region) or Ongoing orthodontic treatment. The sample size was calculated using the OpenEpi® statistics calculation software **[6]**, considering a confidence level of 95%, power of 80% using the study of[1] as a reference. Therefore, the minimal sample size required was 176 cases. Out of the 1000 CBCT images, 600 were selected randomly. After applying the exclusion criteria, 265 CBCT images were excluded. The final sample size became 335 CBCT images. The sample size was divided according to gender (male and female), age (> 45 years and ≤ 45 years), and dental condition (dentate and edentulous). Patients underwent CBCT assessment were referred from general practitioners, maxillofacial surgery departments and surgeons for various surgical treatments, including dental implant placement. CBCT images were stored into an external hard disk. the data were collected during 4 months; from November 2020 to October 2021.

Ethical approval

Prior to the study, ethical approval to carry out this study was granted from the ethical committee of the Faculty of Medicine and Health Sciences, University of Science & Technology

Study variables:

Nasopalatine canal (NPC) dimensions The NPC length was measured through drawing a line from the midpoint of the incisive foramen to the midpoint of the nasal foramen **[1]** And the NPC diameter was assessed at its two openings: oral/palatal opening (incisive foramen) and nasal opening (Stenson's foramina), (Figure 1), respectively



Blue color for NPC length.
Red color for IF diameter.
Green color for NF diąmeter

Figure 1. CBCT image showing the NPC measurements

Statistical analysis: Data analysis will be done using the Statistical Package for Social Sciences (SPSS) software version 24. Statistically significance set at *P* value <0.05.

The Kolmogorov-Smirnov test was applied for evaluating compliance with the normal distribution of the data. Independent t-test and nonparametric Mann-Whitney test. Chi-square test was used to compare the categorical data. Student *t*-test was performed for the comparison of two independent groups.

Study reliability: Intra-examiner reliability was assessed by recording 10% of the study measurements randomly and blindly across three trials with a one-week interval. The correlation between the recorded measurements were statistically evaluated using the intraclass correlation coefficient (ICC) descriptive statistic. The intra-examiner reliability data demonstrated a mean percentage agreement of 91.1% for the single measures and 96.9% for the average measures indicating excellent agreement reliability [15, 16].

RESULTS

A total of 335 CBCT images of patients were analyzed according to gender, age (18-45 and > 45 years), and dental condition (dentate and edentulous) as shown in Figure 4.1, 4.2.

Table 4.1 presents the descriptive statistics of NPC measurements along with their normality test. The NPC mean length was 9.93±2.30 mm (ranging from 5.10 to 16.00 mm). Besides, the NPC mean diameter at both incisive and nasal foramens was 3.03±0.80 mm (ranging from 1.00 to 5.10 mm) and 3.16±1.21 mm (ranging from 1.00 to 6.10 mm), respectively.

Regarding the gender, age and dental condition, as shown in Table 4.2 The results revealed that the NPC mean length is significantly higher in males than females (10.80±2.15 vs 9.39±2.23 mm, p=0.000) where the mean difference is 1.41 mm.

Moreover, the NPC mean length is higher in the > 45 years group than the 18-45 years group (10.17±2.36 vs 9.86±2.28) and in the edentulous than dentate patients (10.20±2.32 vs 9.86±2.29); however, these differences are not statistically significant (p>0.05).The results also revealed that the NPC mean length is significantly higher in those missing only one central incisor than those missing both (10.94±2.14 vs 9.62±2.13, p=0.018) where the mean difference is 1.32 mm.

The differences of NPC diameter at the incisive foramen according to gender, age and dental condition, as shown in Table 4.3 The results revealed that the NPC mean diameter at the incisive foramen is significantly higher in males than females (3.19±0.82 vs 2.92±0.78 mm, mean difference=0.27, p=0.003), in the > 45 years group than those between 18-45 years (3.23±0.86 vs 2.97±0.78 mm, mean difference = 0.26, p=0.015), in the edentulous than the dentate patients (3.21±0.77 vs 2.98±0.81 mm, mean difference = 0.23, p=0.034), and in those missing both central incisors than those missing only one (3.39±0.74 vs 2.92±0.73 mm, mean difference = 0.47, p=0.011).

The differences of NPC diameter at the nasal foramen according to gender, age and dental condition, as shown in Table 4.4 The results revealed that the NPC mean diameter at the nasal foramen is significantly higher

in males than females (3.43±1.19 vs 2.99±1.20 mm, p=0.001) where the mean difference is 0.44.

Moreover, the NPC mean diameter at the nasal foramen is higher in the 18-45 years group than the > 45 years group (3.17±1.24 vs 3.12±1.10), in the dentate than edentulous patients (3.22±1.25 vs 2.92±1.02) and in those missing one than those missing both central incisors (2.93±1.05 vs 2.92±1.01); however, these differences are not statistically significant (p>0.05).

Table 1 Descriptive results of sample according to demographic variables

variable			N	%
Gender		Male	129	38.5
		Female	206	61.5
Age		18-45 years	259	77.3
		> 45 years	76	22.7
Dental condition		Dentate	267	79.7
		Edentulous	68	20.3
total			**335**	**100**

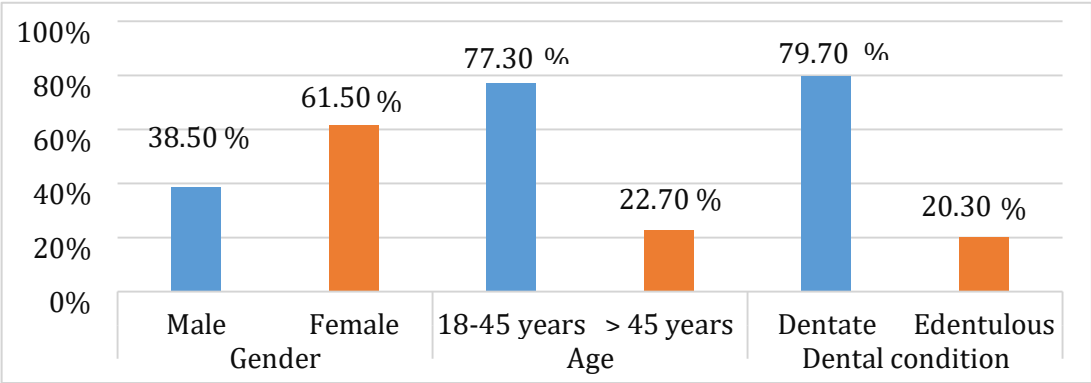


Figure 2. Descriptive results of sample according to demographic variable

Table 2 Edentulous group according to number of missing central incisors

Edentulous	N	%
Missing both	41	60.29
Missing one	27	39.71
Total	68	100

Table 3. Differences of NPC length by gender, age and dental condition

NPC length		N	Mean	SD	Mean difference	*P*
Gender	Male	129	10.80	2.15	1.41	.000*
	Female	206	9.39	2.23		
Age	18-45 years	259	9.86	2.28	-0.31	.223
	> 45 years	76	10.17	2.36		
Dental condition	Dentate	267	9.86	2.29	-0.34	.215
	Edentulous	68	10.20	2.32		
	Missing both CIs	41	9.62	2.13	-1.32	.018*
	Missing one CI	27	10.94	2.14		

* Statistically significant at p<0.05, CI: Central Incisors.

Table 4. Differences of NPC diameter at the incisive foramen by gender, age and dental condition

NPC diameter at incisive foramen		N	Mean	SD	Mean difference	*P*
Gender	Male	129	3.19	.82	.27	.003*
	Female	206	2.92	.78		
Age	18-45 years	259	2.97	.78	-.26	.015*
	> 45 years	76	3.23	.86		
Dental condition	Dentate	267	2.98	.81	-.23	.034*
	Edentulous	68	3.21	.77		
	Missing both CIs	41	3.39	.74	.47	.011*
	Missing one CI	27	2.92	.73		

* Statistically significant at p<0.05, CI: Central Incisors.

Table 5.Differences of NPC diameter at the nasal foramen by gender, age and dental condition

NPC diameter at nasal foramen		N	Mean	SD	Mean difference	*P*
Gender	Male	129	3.43	1.19	.44	0.001*
	Female	206	2.99	1.20		
Age	18-45 years	259	3.17	1.24	.05	.805
	> 45 years	76	3.12	1.10		
Dental condition	Dentate	267	3.22	1.25	.30	.068
	Edentulous	68	2.92	1.02		
	Missing both CIs	41	2.92	1.01	-.01	.940
	Missing one CI	27	2.93	1.05		

* Statistically significant at p<0.05, CI: Central Incisors

DISCUSSION

CBCT images of 335 randomly selected patients referred for the purpose of undergoing dental implant procedures to a private radiology center at Sana'a city, Yemen during the period from January 2017 to December 2019. The study results would be helpful to provide normative data and guidelines and disseminate knowledge to dentists and surgeons in Yemen and raise their awareness in order to obtain sufficient and updated pre-surgical information to successfully perform dental implant procedures in the anterior maxillary area and avoid any possible complications or dental implant failure.

Nasopalatine canal

The study found that the NPC mean length of Yemeni patients was 9.93±2.30 mm, which was smaller than those of other countries all over the world, including India (18.63, 12.14, 11.13, 10.66, 10.32, 10.25, & 10.08 mm)[9,11,17-21] Malaysia (16.33 mm)[5], Iran (14.09, 12.85, and 12.84, 12.7, & 10.34 mm)[22-25] China (12.8mm) [26], Turkey (12.59, 12.56, & 11.45 mm) **1,27,** Spain (12.34 mm)[10], Lebanon (11.52mm)[28], Korea (11.5mm)[29], Japan (11.29mm)[30], Germany (11.15 mm) [13], Brazil (11mm) [12], Switzerland (10.99 mm)[8], and Serbia (10.26 mm) [4].

However, it is higher than those of different samples in Turkey (9.62 & 9.53 mm)[31] and Germany (8.1mm)[14].

Regarding the variations in the NPC dimensions across various studies, [32] and [5] stated that since there are several differences in the NPC dimensions within one population, they are most likely to exist between various populations with different races and ethnicities.

Regarding gender, the present study revealed that the NPC mean length of male patients was significantly higher than that of females (p<0.001), which is similar to those reported by most previous studies [1, 5, 8, 9, 11-13, 19, 20, 23-25, 27, 28, 33].

The higher NPC length in males could be attributed to the relatively larger facial craniocaudal dimensions in males than females; therefore, the variations in the NPC dimensions may be relative to the facial dimensions [21].

However, few studies showed no significant difference in the NPC mean length between both genders [17, 18, 22, 31, 34].

Besides, the present study showed no significant difference in the NPC mean length with regard to age (p>0.05), which is comparable to those revealed by most previous studies [1, 5, 9, 13, 19, 34]. This finding is however inconsistent to [17] in India who reported significantly increased NPC length with aging as well as [12] in Brazil and [8] in Switzerland who reported significant lower values of NPC length for older patients.

The present study also showed that the NPC mean length is not associated with the dental condition (p>0.05), which complies with those reported by some previous studies [1, 8, 18, 22, 30], but does not comply with those reported by others, including who conducted their study on patients from Turkey, Spain, Saudi Arabia, and Cyprus as well as [31] who reported significant lower values of NPC length for edentulous patients.

The insignificance differences in the NPC length regarding age and dental condition in the present study as well as in most of the previous studies could be attributed to the interindividual variations and non-homogenous distribution of age and dental groups [1].

At the incisive foramen, the NPC mean diameter in the present study was 3.03±0.80 mm, which is close to the NPC mean diameter reported for the Caucasians/Arabs (2.90mm) by [32]. In contrast, it is smaller than those of several previous studies conducted in many different countries in which the NPC mean diameter at the incisive foramen ranges from 7.51mm to 3.12 mm [1, 8, 9, 11, 13, 14, 17-19, 22-25, 28, 30, 34-37], as well as larger than those reported by few studies in which the NPC mean diameter at the incisive foramen ranges between 2.5 mm and 2.8 mm [5, 12,14] reported that the diameter of the incisive foramen is usually considered below 6mm since in case it exceeds 10mm, pathological conditions should be considered. They added that this dimensional variability is very important especially when dealing with surgical procedures such as implant placement in the central incisor region.

Furthermore, the present study revealed a significantly wider NPC mean diameter at the incisive foramen in male patients compared to female patients (p=0.015), which is similar to those reported by several previous studies [1, 5, 13, 20, 22, 24, 25, 32, 33, 36] whereas other studies showed no significant difference in the NPC mean diameter at the incisive foramen between both genders although the value was higher for male participants [10, 13, 25, 31, 34-36 31, 37].

Moreover, the present study showed that the NPC mean diameter at the incisive foramen is significantly higher in the > 45 years group than those between 18-45 years (p=0.034). This finding is similar to those revealed by some previous studies [1, 13, 17] which reported significant higher values of NPC diameter at the incisive foramen for older patients. In contrast, other studies reported insignificant association of NPC diameter at the incisive foramen with age [12, 19, 34, 37].

Besides, the present study showed a significant association of NPC diameter at the incisive foramen with the dental condition indicating that the edentulous group had higher NPC diameter (p=0.011), which is comparable to those reported by previous studies [22, 24, 30, 37], and incomparable to those of few studies [1, 18, 32] which reported insignificant association of NPC diameter at the incisive foramen with the dental condition.

At the nasal foramen, the NPC mean diameter in the present study was 3.16± 1.21 mm, which was similar to that of [20] in India; however, it is smaller than those of several studies conducted in many different countries in which the NPC mean diameter at the nasal foramen ranges from 6.06 mm to 3.17 mm [5, 8, 11, 13, 14, 19, 22, 24, 25, 30, 34, 36]. On contrary, our study reported higher NPC mean diameter than those reported by some studies in which the NPC mean diameter at the nasal foramen ranges between 1.9 mm and 3.1 mm [1, 9, 12, 31, 32, 35].

Furthermore, the present study revealed a significantly wider NPC mean diameter at the nasal foramen in male patients compared to female patients (p=0.001), which is similar to those reported by some previous studies [19, 20, 25, 32] whereas most previous studies showed no significant difference in the NPC mean diameter at the nasal foramen between both genders [1, 5, 8, 11, 13, 22, 24, 34, 36].

The NPC wider diameter at both incisive and nasal foramens in males than females could be attributed to the larger size of skulls and larger dimensions of craniocaudal anatomy in males [9, 21].

Moreover, the present study showed that the NPC mean diameter at the nasal foramen is not significantly associated with age (p>0.015). This finding is similar to those revealed by previous studies [1, 12, 13, 19, 23, 34].

Besides, the present study showed no significant association between NPC diameter at the nasal foramen with the dental condition (p>0.015), which is comparable to those reported by some previous studies [1, 22, 24, 32], and incomparable to those of[30] and[31] who reported who reported significant higher values of NPC diameter at the nasal foramen for edentulous patients.

The present study results regarding the relationship of the NPC diameter at the nasal foramen with age and dental condition are supported by the conclusion of [38] who reported that contrary to the alveolar bone which undergoes major vertical and horizontal resorption, the shape of the nasal/basal bone does not dramatically change with age and following tooth loss.

The variation in NPC length and diameter as within different countries could be attributed to the reginal and environmental factor. Moreover, despite of the variations in mean dimensions of NPC their specific variations should be taken into account when placing endosseous implant in the anterior maxilla.[5]

In summary, there is great variability in the dimensions of the NPC in the anterior maxilla, even within subjects of the same origin. These differences appear to be gender- and age-specific as well as of ethnic differences. Nonetheless, the findings of this study provided detailed anatomical variations of the NPC therefore, it can be described as a seminal reference and beneficial to further research studies in dentistry as well as to dentists in various centers and dental clinics in Yemen where CBCT is not available. In particular, the study findings could be also helpful to dental implant surgeons who could raise their understanding of the NPC structure to avoid any potential NPC perforation which could hinder the success of osseointegration.

DECLARATIONS

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Conflicts of interest

Authors **have no conflicts** of interest to disclose.

- The study protocol was reviewed and approved by the research ethical committee of by the College of Dentistry, University of Science & Technology, Sanaa, Yemen, letters were send to hospital manager to permit to conduct the study.

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REFERENCES

1. Görürgöz, C. and B. Öztaş, *Anatomic characteristics and dimensions of the nasopalatine canal: a radiographic study using cone-beam computed tomography.* Folia morphologica, 2021. **80**(4): p. 923-934.
2. Lake, S., et al., *The incisive canal: a comprehensive review.* Cureus, 2018. **10**(7).
3. Merheb, J., M. Quirynen, and W. Teughels, *Critical buccal bone dimensions along implants.* Periodontology 2000, 2014. **66**(1): p. 97-105.
4. Milanovic, P., et al., *Morphological characteristics of the nasopalatine canal and the relationship with the anterior maxillary bone—a cone beam computed tomography study.* Diagnostics, 2021. **11**(5): p. 915.
5. Al-Amery, S.M., et al., *Cone beam computed tomography assessment of the maxillary incisive canal and foramen: considerations of anatomical variations when placing immediate implants.* PloS one, 2015. **10**(2): p. e0117251.
6. Sullivan, K.M., A. Dean, and M.M. Soe, *On academics: OpenEpi: a web-based epidemiologic and statistical calculator for public health.* Public health reports, 2009. **124**(3): p. 471-474.
7. Mardinger, O., et al., *Morphologic changes of the nasopalatine canal related to dental implantation: a radiologic study in different degrees of absorbed maxillae.* Journal of periodontology, 2008. **79**(9): p. 1659-1662.
8. Bornstein, M.M., et al., *Morphology of the nasopalatine canal and dental implant surgery: a radiographic analysis of 100 consecutive patients using limited cone-beam computed tomography.* Clinical oral implants research, 2011. **22**(3): p. 295-301.
9. Thakur, A.R., et al., *Anatomy and morphology of the nasopalatine canal using cone-beam computed tomography.* Imaging science in dentistry, 2013. **43**(4): p. 273-281.

10. Fernández-Alonso, A., et al., *Three-dimensional study of nasopalatine canal morphology: a descriptive retrospective analysis using cone-beam computed tomography.* Surgical and radiologic anatomy, 2014. **36**: p. 895-905.
11. Jain, N.V., et al., *Three-dimensional analysis of the anatomical characteristics and dimensions of the nasopalatine canal using cone beam computed tomography.* Journal of maxillofacial and oral surgery, 2017. **16**: p. 197-204.
12. Aranha Neto, I.S., et al., *Morphometric study of incisive canal and its anatomic variations in brazilian individuals.* CRANIO®, 2024. **42**(1): p. 94-101.
13. Friedrich, R.E., et al., *The nasopalatine canal in adults on cone beam computed tomograms–A clinical study and Review of the literature.* In vivo, 2015. **29**(4): p. 467-486.
14. Mraiwa, N., et al., *The nasopalatine canal revisited using 2D and 3D CT imaging.* Dentomaxillofacial Radiology, 2004. **33**(6): p. 396-402.
15. Cicchetti, D.V., *Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology.* Psychological assessment, 1994. **6**(4): p. 284.
16. Koo, T.K. and M.Y. Li, *A guideline of selecting and reporting intraclass correlation coefficients for reliability research.* Journal of chiropractic medicine, 2016. **15**(2): p. 155-163.
17. Soumya, P., et al., *Maxillary incisive canal characteristics: a radiographic study using cone beam computerized tomography.* Radiology research and practice, 2019. **2019**(1): p. 6151253.
18. Gopal, K.S. and P. Kapoor, *Evaluation of nasopalatine canal using cone beam computed tomography–A retrospective study.* 2019.
19. Panda, M., et al., *Cone beam computerized tomography evaluation of incisive canal and anterior maxillary bone thickness for placement of immediate implants.* The Journal of Indian Prosthodontic Society, 2018. **18**(4): p. 356-363.
20. Rao, J.B., et al., *Radiographic Assessment of Anatomy of Nasopalatine Canal for Dental Implant Placement: A Cone Beam Computed Tomographic Study.* The journal of contemporary dental practice, 2018. **19**(3): p. 301-305.
21. Mishra, R., et al., *Influence of gender and age on nasopalatine canal: A cone-beam computed tomography study.* Journal of Dental Implants, 2017. **7**(1): p. 15-19.
22. Panjnoush, M., et al., *Evaluation of morphology and anatomical measurement of nasopalatine canal using cone beam computed tomography.* Journal of Dentistry (Tehran, Iran), 2016. **13**(4): p. 287.
23. Safi, Y., et al., *Assessment of nasopalatine canal anatomic variations using cone beam computed tomography in a group of Iranian population.* Iranian Journal of Radiology, 2017. **14**(1): p. e37028.
24. Kajan, Z.D., et al., *Evaluation of the nasopalatine canal with cone-beam computed tomography in an Iranian population.* Dental research journal, 2015. **12**(1): p. 14-19.
25. Khojastepour, L., A. Haghnegahdar, and M. Keshtkar, *Morphology and dimensions of nasopalatine canal: a radiographic analysis using cone beam computed tomography.* Journal of Dentistry, 2017. **18**(4): p. 244.
26. Zhou, Z., et al., *Cone beam computed tomographic analyses of alveolar bone anatomy at the maxillary anterior region in Chinese adults.* Journal of biomedical research, 2013. **28**(6): p. 498.
27. Etoz, M. and Y. Sisman, *Evaluation of the nasopalatine canal and variations with cone-beam computed tomography.* Surgical and Radiologic Anatomy, 2014. **36**: p. 805-812.
28. Nasseh, I., G. Aoun, and S. Sokhn, *Assessment of the nasopalatine canal: An anatomical study.* Acta Informatica Medica, 2017. **25**(1): p. 34.
29. Song, W.-C., et al., *Microanatomy of the incisive canal using three-dimensional reconstruction of microCT images: an ex vivo study.* Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 2009. **108**(4): p. 583-590.
30. Fukuda, M., et al., *Three-dimensional analysis of incisive canals in human dentulous and edentulous maxillary bones.* International journal of implant dentistry, 2015. **1**: p. 1-8.
31. Belgin, C.A. and G. Serindere, *Evaluation of Changes in Nasopalatine Canal Morphology According To Dentition Status by Computed Tomography.* Kocaeli Üniversitesi Sağlık Bilimleri Dergisi, 2020. **6**(3): p. 233-237.

32. Tözüm, T.F., et al., *Evaluation of maxillary incisive canal characteristics related to dental implant treatment with computerized tomography: a clinical multicenter study.* Journal of periodontology, 2012. **83**(3): p. 337-343.
33. Güncü, G.N., et al., *Is there a gender difference in anatomic features of incisive canal and maxillary environmental bone?* Clinical oral implants research, 2013. **24**(9): p. 1023-1026.
34. Talebian, M., S. Etemad, and K.A. Seimareh, *Morphological and anatomical assessment of the nasopalatine canal in edentulous patients using cone beam computed tomography.* Revista publicando, 2018. **5**(16): p. 494-502.
35. Acar, B. and K. Kamburoğlu, *Morphological and volumetric evaluation of the nasopalatinal canal in a Turkish population using cone-beam computed tomography.* Surgical and Radiologic Anatomy, 2015. **37**: p. 259-265.
36. Bahşi, I., et al., *Anatomical evaluation of nasopalatine canal on cone beam computed tomography images.* Folia morphologica, 2019. **78**(1): p. 153-162.
37. Kim, Y.-T., J.-H. Lee, and S.-N. Jeong, *Three-dimensional observations of the incisive foramen on cone-beam computed tomography image analysis.* Journal of Periodontal & Implant Science, 2020. **50**(1): p. 48-55.
38. Cawood, J. and R. Howell, *A classification of the edentulous jaws.* International journal of oral and maxillofacial surgery, 1988. **17**(4): p. 232-236.