Examination of the Relationship of Dental İmplants in the Maxilla with the Nasopalatine Canal by Cone-Beam Computed Tomography

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Abstract

Objective: The aim of this study is to examine the dental implants made in the maxilla on cone-beam computed tomography images and to evaluate their relationship with the nasopalatine canal by classifying them according to the safety margin.
Materials and methods: In our study, CBCT images of 352 implants in 250 (110 male, 140 female) patients aged 22-91 years were evaluated in multiplanar planes. The Kolmogorov-Smirnov test was used to examine the suitability of the available data for normal distribution. Relationships between categorical variables were calculated with the "Chi-square test" and the relationship between numerical variables was calculated with the "One Way Anova test".
Results: The mean age of all cases was found to be 54.03 ± 11.86. No relationship was observed with the nasopalatine duct in 340 (96.6%) of the cases. When analyzed according to gender, no statistically significant difference was found between the nasopalatine canal and typings ($p > 0.05$).
Conclusion: Implants that were not associated with the nasopalatine canal were found to be 96.6%. The number of implants unrelated to the nasopalatine canal was found to be higher.

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Keywords: Cone beam computed tomography, nasopalatine canal, dental implant**.**

Introduction

In dental implant applications, attention should be paid to the characteristics of the bone in the area where the implant will be applied. These features are; the quantity, quality, density of the bone and its relationship with the surrounding anatomical structures and formations. Although the clinical examination is important, radiographic examination in addition to the clinical examination is important for the success of implant applications for factors that will affect the course of treatment, such as the structure and form of the bone, the positions of the anatomical structures (1). Previously, two-dimensional radiographs such as periapical, panoramic and cephalometric were used for the radiological evaluation of implant applications. Because of the limitations of these radiographs, computed tomography has begun to be used. In particular, the ability to examine the bone dimensions in millimeters, to determine the bone density, and to show the relationship of the surgical area with anatomical formations in detail has allowed this three-dimensional diagnosis method to be preferred more (2). A wide range of error has been reported when making linear measurements on CBCT images, with both over- and under-estimation of dimensions compared to a gold standard. Therefore, a 2

mm safety margin for adjacent anatomical structures should be considered when using CBCT (3). In routine situations or when CBCT is not available, panoramic radiography can provide sufficient information about bone height for implant planning. However, in cases where the margin of safety is not respected due to insufficient bone height, an additional CBCT evaluation may help prevent nerve damage and damage to surrounding anatomical structures (4). One of the challenges with dental implants is the penetration of the implant into nearby anatomical structures. Kaya et al. (5) in their study; made recommendations for the three types of nerve injuries: neuropraxia, axonotmesis, and neurotmesis, depending on the severity, prognosis, and recovery time of tissue damage. They stated that neurapraxia is the mildest type and neurotmesis is the most severe type, and that both the doctor and the patient will have an unpleasant experience with sensory disturbances resulting from the injury. Peripheral sensory nerve injuries are more likely to be permanent as the time between injury and patient review increases; therefore, early diagnosis is the key to successful treatment (5). There are few studies in the literature examining the relationship between dental implants in the maxilla and the nasopalatine canal(6, 7).

The aim of this study is to examine the dental implants made in the maxilla on CBCT images and to evaluate their relationship with the nasopalatine canal by classifying them according to the margin of safety.

Materials and methods

Ethical approval of our studyIt was taken by the decision of the Gaziantep University Clinical Research Ethics Committee numbered 2021/118. In our study, images taken with Planmeca 3D Mid (ProMax, Helsinki, Finland) CBCT device between 2017-2021, which are in the tomography archive of Gaziantep University Oral, Dental and Maxillofacial Radiology Department, were used. All images were taken by experienced personnel. In the study, images with FOV (field of viewer) of 16x16, 16x9, 16x5 cm, 0.4 mm3 voxel resolution, irradiation parameters of 90 kVp, 12 mA, exposure time of 14-27 seconds and slice thickness of 1 mm, Planmeca Romexis Viewer 3.2.0 version (Helsinki, Finland) software was analyzed. Inclusion criteria for the study: CBCT images with implants in the maxilla, absence of distortion, magnification, foreign object etc. images in the examination area. In our study, CBCT images of 352 implants in 250 (110 male, 140 female) patients aged 22-91 years were evaluated in multiplanar planes

Evaluation of data

The classification of implants according to their distance from the surrounding anatomical structures is given below:

- Type 1: implant associated with the nasopalatine canal
- Type 2: implant with 1-2 mm distance from the nasopalatine canal
- Type 3: implant with a distance greater than 2 mm from the nasopalatine canal
- No Relationship: Implants outside the examined area

By measuring the distance of the implants made in the maxilla to the nasopalatine canal (figure 1), type 1, type 2, type 3 and unrelated implants were classified as no relationship. Evaluations on the implants (20% of the images) in 50 patient images were repeated 2 weeks later to calculate the reliability of the measurements and the intra-observer agreement.

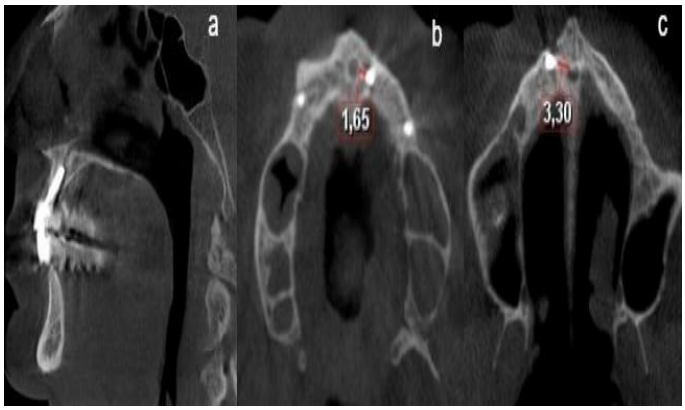

Fıgure 1. Sagittal and axial CBCT sections (a) type 1 implant associated with the nasopalatine canal, (b) implant in type 2 relationship with the nasopalatine canal, (c) type 3 implant.

Statistical analysis

In our study, the determination of intra-observer consistency in radiographic evaluations was tested with kappa. The Kolmogorov-Smirnov test was used to examine the suitability of the available data for normal distribution. Relationships between categorical variables were calculated with the "Chi-square test" and the relationship between numerical variables was calculated with the "One Way Anova test". As descriptive statistics, number (n) and percent (%) values were given for categorical variables, and mean ± standard deviation (Mean ± SD) for numerical variables. SPSS Windows version 22.0 (Armonk, NY: IBM) package program was

used for statistical analysis and $p < 0.05$ was considered statistically significant.

Results

Intra-observer agreement was evaluated with the kappa test and was found to be excellent (0.91). In our study, CBCT images of 352 implants were evaluated in multiplanar planes in a total of 250 patients, 110 (44%) men and 140 (56%) women. The ages of all cases were between 22 and 91, and the mean age was 54.03 ± 11.86. The mean age of women was 52.86 ± 12.60, and 55.51 ± 10.71 for men. The distribution of the distance of the implants from the nasopaltine canal according to the types is shown in Table 1. Considering its relations with the nasopalatine canal, type 1; 5 (1.4%), type 2; 2 (0.6%), type 3; It was found to be 5 (1.4%). No relationship was found with the nasopalatine duct in 340 (96.6%) of the cases. The distribution of the typing of the maxillary sinus and implant relationships by gender is shown in Table 2. When the relationship of the implants with the nasopalatine canal is examined according to gender, type 1 in women; 1 (0.3%), type 2; 2 (0.6%), type 3; It was determined as 3 (0.9%). In men, this rate is type 1; 4 (1.1%), type 2; 0 (0.0%), type 3; It was found as 2 (0.6%). When analyzed according to gender, no statistically significant difference was found between the nasopalatine canal and typings ($p > 0.05$). The distribution of the typing of the distance of the implants from the nasopalatine canal according to the mean age is shown in Table 3. The mean age of the cases with typed implants in relation to the nasopalatine canal was 58.20 ± 5.16 for type 1, 51.00 ± 4.24 for type 2, and 54.40 ± 13.48 for type 3. The mean age of the cases not related to the nasopalatine duct was found to be 54.96 ± 9.28 years. When analyzed according to mean age, no statistically significant difference was found between the nasopalatine canal and typings ($p > 0.05$).

Table 1. The distribution of the distance of the implants to the nasopalatine canal according to the types.

	Nasopalatine canal
Implant typings	N (%)
Type 1	5 (1.4)
Type 2	2 (0.6)
Type 3	5 (1.4)
No realtionship	340 (96.6)
Total	352 (100)

Table 2. The distribution of the typing of the nasopalatine canal and implant relationships by gender.

	Nasopalatinecanal				
Gender	**Type 1 N (%)**	**Type 2 N (%)**	**Type 3 N (%)**	**No relatoinship N (%)**	**P**
Female	1 (0.3)	2 (0.6)	3 (0.9)	190 (54.0)	0.239
Male	4 (1.1)	0 (0.0)	2 (0.6)	150 (42.6)	

$P < 0.05$

Table 3. The distribution of the type of implants according to the distance from the nasopalatine canal according to the mean age.

		N (%)	Mean ± SD	P
Nasopalatinecanal	Type 1	5 (1.4)	58.20 ± 5.16	0.804
	Type 2	2 (0.6)	51.00 ± 4.24	
	Type 3	5 (1.4)	54.40 ± 13.48	
	No relationship	340 (96.6)	54.96 ± 9.28	

Discussion

Dental implants have increased in recent years and therefore the number of complications has also increased. Because many of these complications are easily diagnosed on post-operative images, it is important for radiologists to be familiar with, recognize, and diagnose them. Radiologists should also have a basic understanding of their treatment (8). In the literature, anatomical structures and variations in the maxilla and mandible were evaluated before dental implant treatment (9), and no classification or study was found according to the safety distance to the anatomical structures in the maxilla and mandible after implantation. To the best of our knowledge, our study is the first to examine the distance to anatomical formations and surrounding structures by classifying according to the post-implant safety interval. One of the challenges with dental implants is the penetration of the implant into nearby anatomical structures.In our study, the prevalence was evaluated according to the classification made by measuring the distance of the implants made before in the maxilla with the nasopalatine canal, and also examined according to age and gender. The nasopalatine canal is surgically important and has anatomical and morphometric variations according to race and ethnicity. However, three-dimensional imaging is important for anatomical variations obtained in terms of dimensional and morphological parameters. The most important

parameters for the placement of implants in the maxillary incisor region are; the shape, curvature and antero-posterior dimensions of the canal (10). Pamukcu et al. (6) retrospectively analyzed a total of 103 CBCT images of 61 (59.2%) female and 42 (40.8%) male patients with at least one dental implant in the mandible or maxilla, with a mean age of 55.1 ± 14.4 years. Nasopalatine duct perforation was observed in 7 (2.4%) of the cases. Gaêta-Araujo et al.(7), examining CBCT images of 339 individuals with implants, found incisive canal perforation to be 15 (1.3%). In this study, those in close proximity to and associated with the nasopalatine canal were evaluated as type 1 implants, and a type 1 relationship was found in 5 (1.4%) of the cases. This result is consistent with the rates in these studies. In the study of Alkendari et al.(11), firstly, measurements related to the canal were made. Secondly, digital prosthesis planning was done. The immediate implants were then placed virtually and additional measurements were made. The perforation rate was evaluated. A total of 217 scans met the inclusion criteria. Nasopalatine duct perforation was seen in only 8% of cases. Perforation occurred in the middle third or middle and apical third of the implant in 33% and 22% of cases, respectively. In another study, it was reported that the contents of the nasopalatine canal can be emptied by enucleation in the presence of accidental perforation of the canal while creating an osteotomy for the implant, severe atrophy in the maxilla, and a wide foramen that prevents the placement of an implant in the desired location (12).

Limitations of this study; It is not known whether CBCT is used in preoperative planning, there is no further clinical information such as intraoperative complications, symptoms and systemic diseases of the patients.

Conclusion

No relationship was found with the nasopalatine canal in 96.6% of the cases. The number of implants unrelated to the nasopalatine canal was found to be higher. When analyzed according to gender, no statistically significant difference was found between the nasopalatine canal and typings. When analyzed according to mean age, no statistically significant difference was found between the nasopalatine canal and typings. In future studies, the number of data can be increased by including preop and postop clinical and radiological data, and more comprehensive studies can be done according to age groups.

Descriptions

Author Contrubitions:

MED: study design, data collection/processing, analysis, interpretation, literature review, and manuscript writing contributed in its departments and stages.

EDY: design, consulting and critical review in the study **contributed to the stages**

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