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ORIGINAL ARTICLE

Evaluation of the incisive canal using cone beam computed tomography

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ABSTRACT

The incisive canal is innervated by the nasopalatine nerve and irrigated by the anterior branches of the descending palatine vessels, the sphenopalatine and greater palatine artery. Sometimes, the incisor canal interferes with the placement of implants or other surgical procedures, it is necessary to resort to previous treatments in order to have the ideal conditions in the area to be treated and avoid complications. Methods: 100 cone beam computed tomography were studied evaluating the diameter, length and shape of the incisor canal, distance from the lower edge of the incisor canal to the alveolar ridge, length and width of the bone anterior to the incisor canal, and width of the palatal bone. Results and conclusions: The variables that showed a statistically significant difference comparing between male and female patients were vestibulo-palatal and incisor foramen diameter, incisor canal length, distance from the canal to the central incisor, coronal and medial width of the vestibular bone; and the width of the palatal bone at apical and mid-level; being greater in male patients.

KEY WORDS
Incisive canal; Cone beam computed tomography.

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INTRODUCTION

The rehabilitation of the maxillary anterior sector is a challenge in both surgical and prosthetic aspects. There are two limitations in the anterior maxilla, one is bone resorption following incisor extraction, and the other is the location of the incisor canal[(1)].

Cone beam computed tomography (CBCT) studies have improved and helped to understand the anatomical and morphometric variability of the incisor canal, in terms of position, length, diameter and shape[(2)].

Evidence has been shown to indicate that factors such as age, gender, tooth loss, and trauma can alter measurements of both the incisor canal, as well as primarily the vestibular bone width[(3)].

Anatomical structures such as nerves and vessels are always of great consideration in implant placement, since a safe distance should be kept between critical anatomical points[(4)]. Due to the proximity between the incisor canal and the roots of the upper central incisors, it could be a challenge to think about implant treatment. Situations where either implant placement, guided bone regeneration procedures or any other surgical intervention in the anterior zone inevitably invades the incisor canal, actions can be proposed to prevent contact with the neurovascular bundle[(5)].

Due to the large number of variations that may exist in the anatomy of the incisor canal, it is of utmost importance to perform a correct preoperative evaluation, to provide an adequate diagnosis and therefore an accurate treatment plan; thus avoiding damage to nerves or vessels, and subsequent complications such as sensory dysfunction, hemorrhage, and even in the treatment of implants a failure in osseointegration[(6)].

The aim of the present study was to evaluate the diameter, length and shape of the incisor canal, the distance from the lower edge of the incisor canal to the alveolar ridge, the length and width of the bone anterior to the incisor canal and the length and width of the palatal bone, using CBCT as a diagnostic tool.

METHODS

The study design is descriptive, open, observational, retrospective and cross-sectional. Based on the nature of the quantitative variables, a sample size of 100 CBCT was estimated. A total of 100 CBCTs of patients who attended the Scan3D radiology center, located in San Pedro Garza García and Monterrey, Nuevo León, were evaluated; a database was provided which did not have patient identity information.

Selection criteria:

Inclusion criteria.

Patients of both sexes, patients older than 18 years, dentate, partially edentulous and totally edentulous patients who for any reason underwent cone beam computed tomography at the Scan3D radiology center were included.

Exclusion criteria.

Those tomographies in which the patients showed a deviation between the anterior nasal spine and the dental midline, patients with evidence of radiographic bone loss, presence of endodontal lesions, the presence of impacted anterior teeth, who had some previous surgical intervention were excluded. study in the anterior area, and patients with suspected pathology related to the incisive canal.

Elimination criteria.

CBCTs that did not have adequate contrast for the required evaluation were eliminated.

CBCT selection

100 CBCTs were selected from a database provided by the Scan3D radiology center, grouping patients according to whether they were dentate, partially edentulous (absence of anterior teeth) and totally edentulous, and according to sex.

Measurements

If they met the established inclusion criteria, the following measurements were taken:

1) **Incisor canal diameter in coronal cut:** In a coronal cut, the incisor canal was measured at the point where the entrance of the canal delimited by the cortex was noted; two measurements were taken at this point, both mesio-distally and apico-coronally (Fig. 1a).

2) **Distance from the incisor canal to the central incisors:** In the same coronal section, the distance from the canal cortex to the mesial of both the right and left central incisor was taken. These measurements were omitted in partially and totally edentulous patients (Fig. 1b).

3) **Canal diameter in a sagittal section:** This measurement was

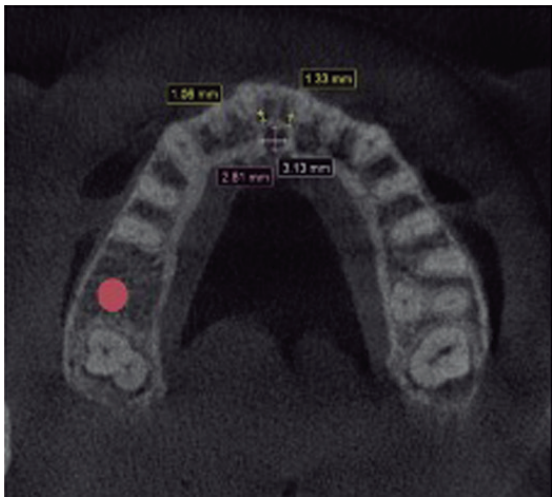

Figure 1. a) Diameter of the incisive canal in a coronal slice. b) Distance from the incisive canal to the central incisors.

taken in such a way that the dental midline and the anterior nasal spine were taken as a reference, taking three measurements, the first at the entrance of the canal which was considered to be the incisor foramen, at a more apical level which was the nasopalatine foramen, and a third measurement at the middle of both (Fig. 2).

4) **Length of the incisor canal:** In the sagittal section the measurement was taken from the incisor foramen to the nasopalatine foramen (Fig. 2).

5) **Shape of the canal:** According to the data obtained in the sagittal section on the diameter of the canal, the canal was classified according to the shape depending on whether it was cylindrical, funnel-shaped, hourglass-shaped or banana-shaped.

6) **Entrance of the canal to the alveolar ridge:** In the sagittal section, the canal entrance was measured from the entrance of the canal where the measurement was taken from the incisor foramen to the alveolar ridge (Fig. 2).

7) **Vestibular bone to the incisor canal:** In the sagittal section, three measurements were taken for this variable, the first at coronal level at the same height of the incisor foramen, another measurement at the height of the anterior nasal spine and the last one at the middle of both (Fig. 2).

8) **Palatine bone:** Three measurements were taken in the sagittal section, the first one at the level of the incisive foramen, the next one at the level of the nasopalatine foramen and the third one dividing both in half (Fig. 2).

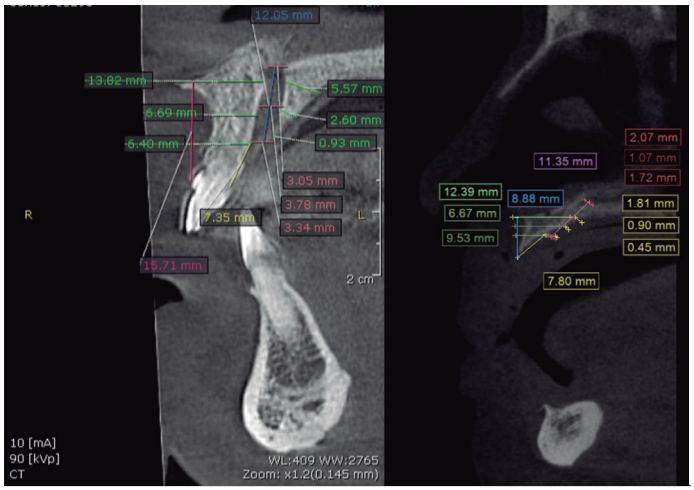

Figure 2. Sagittal slice measurements in dentate and totally edentulous patients.

Statistical analysis

One of the analytical statistical models of the present project consisted of the application of goodness-of-fit tests for 2 variables. After this model, an analytical model for verification of hypothesis testing was performed, considering the data presented in the general objective, the model corresponds to the application of the goodness-of-fit test or Chi-square test.

This test, which was evaluated with 95% reliability, was used to determine if there is a significant relationship between the evaluation of the shape of the incisor canal and the sex of the patients.

The other analytical statistical model consisted of the application of a comparative analysis by means of a t-test of difference of means for independent samples, since the variable showed evidence of normality, this test was determined considering a 95% reliability. The model applied to compare the differences between the mean of the study variables and the sex of the patients.

Ethical considerations

All procedures were in accordance with the stipulations of the Regulations of the General Health Law on Health Research. The present study was approved by the Bioethics Committee of the School of Dentistry of the Universidad Autónoma de Nuevo León.

RESULTS

Evaluation of 100 CBCTs was performed, however, only 85 met the inclusion criteria, of which 30 were dentated, 30 partially dentated and 25 fully edentulate. Fifteen CBCTs were excluded for the following reasons: four because there was a deviation between the anterior nasal spine and the dental midline, four presented retained teeth in the anterior sector of the maxilla, four showed evidence of radiographic bone loss and three did not have adequate quality to perform the corresponding evaluation. Forty-seven CBCTs corresponding to female patients (55.29%) and 38 corresponding to male patients (44.70%) were evaluated.

ANALYSIS ACCORDING TO TOTAL CBCT EVALUATED

Evaluation of the diameter of the incisive canal in a coronal slice

During the evaluation of the entrance of the incisive canal in a coronal section, measurements were taken both in mesio-distal and vestibulo-palatal direction, finding a mean in female patients in mesio-distal direction of 3.25± 1.06 mm, and in male patients of 3.57± 1.08 mm, where the difference is not statistically significant (P=0.0852). In vestibulo-palatal direction the mean in female patients is 3.29± 0.95 mm and in male patients 3.69± 1.05 mm, which obtained a statistically significant difference (P=0.0357) (Table 1).

Evaluation of the diameter in a sagittal slice

In relation to the evaluation of the diameter of the incisor foramen in a sagittal section in female patients the average found was 2.96 ± 0.91 mm and in male patients 3.29 ± 0.95 mm, finding a statistically significant difference (P=0.0516). Regarding the diameter of the nasopalatine foramen the average in women was 2.46 ± 1.18 mm and in men 2.77 ± 1.32 mm, where there was no statistically significant difference (P=0.1286). In the measurement of the middle part of the canal, a mean of 2.12 ± 1.00 mm was obtained in females and 2.24 ± 0.79 mm in males, considering that there was no statistically significant difference (P=0.2704) (Table 1).

Evaluation of incisive canal length

Regarding the length of the incisor canal in a sagittal cut in females the mean obtained was 9.96 ± 2.31 mm and in males 11.87 ± 2.13 mm, finding a statistically significant difference (P=0.0001) (Table 1).

Evaluation of the distance of the canal to the central incisors

In the evaluation of the distance at which the incisor canal was located mesial to the upper central incisors, it was obtained that in the right central incisor in females the mean was 1.59 ± 0.57 mm, and in males 1.92 ± 0.71 mm, showing a statistically significant difference (P=0.0133). In the left central incisor in females a mean of 1.54 ± 0.63 mm was obtained, and in males 1.83 ± 0.66 mm, showing a statistically significant difference (P=0.0319) (Table 1).

Evaluation of the distance from the canal entrance to the alveolar ridge

In relation to the distance from the incisor canal entrance to the alveolar ridge the results showed a mean of 9.64 ± 2.54 mm in females and in males 9.49 ± 3.03 mm, where no statistically significant difference was found (P=0.4001) (Table 1).

Evaluation of the vestibular bone to the incisive canal

Regarding the evaluation of the vestibular bone to the incisor canal, the length of the vestibular bone was evaluated where females obtained a mean of 17.54 ± 3.94 mm, and males obtained 18.15 ± 3.93 mm, where there is no statistically significant difference (P=0.2394). Regarding the width of the vestibular bone in the coronal area at the level of the entrance

Table 1. Comparison of variables by patient gender

				Female			Male			
				Mean	SD	Variance	Media	SD	Variance	P Value
Diameter in coronal section	Mesio-distal	Mesio-distal		3.25	1.06	1.12	3.57	1.08	1.16	0.0852
	Vestibulo-palatino	Vestibulo-palatino		3.29	0.95	0.91	3.69	1.05	1.11	0.0357
Diameter	Incisive Foramen	Incisive Foramen		2.96	0.91	0.84	3.29	0.95	0.90	0.0516
	Middle	Middle		2.12	1.00	1.01	2.24	0.79	0.63	0.2704
	Nasopalatine Foramen	Nasopalatine Foramen		2.46	1.18	1.38	2.77	1.32	1.73	0.1286
Length of the incisive canal		Length of the incisive canal		9.96	2.31	5.34	11.87	2.13	4.54	0.0001
Distance of the canal to the central incisors	Right	Right		1.59	0.57	0.32	1.92	0.71	0.50	0.0133
	Left	Left		1.54	0.63	0.40	1.83	0.66	0.43	0.0319
Distance from the canal entrance to the alveolar ridge		Distance from the entrance		9.64	2.54	6.45	9.49	3.03	9.20	0.4001
Vestibular bone		Length	Length	17.54	3.94	15.49	18.15	3.93	15.42	0.2394
	Width	Coronal	Coronal	6.32	1.69	2.85	7.96	1.68	2.82	0.0000
		Middle	Middle	7.09	1.54	2.38	8.03	1.71	2.93	0.0045
		Apical	Apical	12.60	2.63	6.94	13.04	1.98	3.91	0.1961
Palatine	Width	Coronal	Coronal	1.45	0.53	0.28	1.51	0.41	0.16	0.2832
		Middle	Middle	3.50	1.10	1.21	3.91	0.89	0.79	0.0349
		Apical	Apical	5.46	1.58	2.49	6.33	1.65	2.72	0.0080

of the incisor canal, a mean of 6.32 ± 1.69 mm was obtained in women and 7.96 ± 1.68 mm in men, with a statistically significant difference (P=0.0000). In the width at the most apical level in the direction of the anterior nasal spine, a mean of 12.60 ± 2.63 mm was obtained in women, and in men it was 13.04 ± 1.98 mm, where no statistically significant difference was found (P=0.1961). At the medial level, a mean of 7.09 ± 1.54 mm was obtained in females and 8.03 ± 1.71 mm in males, showing a statistically significant difference (P=0.0045) (Table 1).

Evaluation of the palatal bone to the incisive canal

Regarding the palatal bone or posterior to the incisor canal in the most coronal part, the mean obtained in female patients was 1.45 ± 0.53 mm, and in male patients it was 1.51 ± 0.41 mm, there was no statistically significant difference (P=0.2832). At the middle level the mean in female patients was 3.50 ± 1.10 mm and in male patients 3.91 ± 0.89 mm, showing a statistically significant difference (P=0.0349). At the most apical level the mean in female patients was 5.46 ± 1.58 mm, and in male patients 6.33 ± 1.65 mmm, where it showed a statistically significant difference (P=0.0080) (Table 1).

Evaluation of incisive canal shape

Regarding the shape of the incisor canal in a sagittal section, in the banana shape a total of 6 CBCT (7.06%) of the 85 evaluated were obtained, in which 4 CBCT (8.51%) corresponded to female patients, and 2 CBCT (5.26%) to male patients. In the cylindrical shape, a total of 13 CBCTs (15.29%) were obtained, of which 6 (12.77%) corresponded to female patients and 7 (18.42%) to male patients. In the funnel shape the total was 22 (25.88%), being 11 (23.40%) in female patients and 11 (28.95%) in male patients. In the hourglass shape the total CBCT was 44 (51.76%) being 26 (55.32%) in female patients, and 18 (47.37%) in male patients, however, no statistically significant difference was found (P=0.7389) (Fig.3).

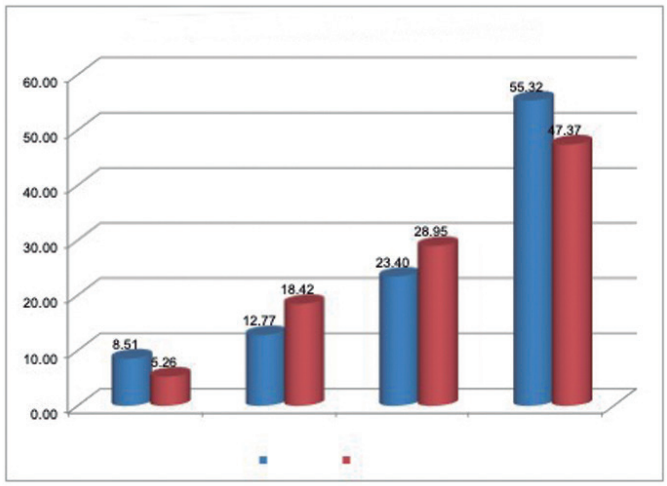

Figure 3. Evaluation of the shape and gender of patients.

ANALYSIS ACCORDING TO THE TYPE OF DENTITION OF THE PATIENT

Evaluation of the diameter of the incisive canal in a coronal section

Comparing the diameter of the incisor canal in the coronal section according to the dentition of the patients, in the mesio-distal direction in dentate patients a mean of 3.42 ± 1.11 mm was obtained, in partial edentulous patients 3.39 ± 0.91 mm and in total edentulous patients 2.96 ± 0.87 mm, which does not show a statistically significant difference (P=0.7162). In the evaluation in the vestibulo-palatal direction, in dentate patients a mean of 3.47 ± 1.02 mm was obtained, in partially edentulous patients 3.34 ± 0.92 mm, and in totally edentulous patients 3.72 ± 1.28 mm, which showed a statistically significant difference (P=0.8216) (Table 2).

Evaluation of the diameter in a sagittal section

In relation to the diameter according to the type of dentition of the patients, in the incisor foramen in dentate patients a mean of 3.05 ± 0.94 mm was obtained, in partial edentulous patients 3.46 ± 0.80 mm, and in total edentulous patients 3.36 ± 1.27 mm, a statistically significant difference was not found (P=0.4109). In the evaluation of the nasopalatine

foramen diameter in dentate patients the mean was 2.51 ± 1.23 mm, in partial edentulous patients 3.30 ± 1.15 mm and in total edentulous patients 2.54 ± 1.45 mm, not showing a statistically significant difference (P=0.1978). In the measurement of the middle part of the canal in dentate patients it was 2.07 ± 0.89 mm, in partial edentulous patients it was 2.87 ± 0.69 mm and in total edentulous patients it was 2.41 ± 1.29 mm, showing a statistically significant difference (P=0.0372) (Table 2).

Evaluation of the length of the incisive canal

According to the length of the canal by dentition of the patients, a mean of 10.66 ± 2.35 mm was found in dentate patients, 12.82 ± 1.94 mm in partially edentulous patients and 9.05 ± 2.52 mm in fully edentulous patients, showing a statistically significant difference (P=0.0117) (Table 2).

Evaluation of canal distance to central incisors.

Comparing the type of dentition of the patients, regarding the distance from the canal to mesial of the central incisors, in the right central incisor in dentate patients a mean of 1.70 ± 0.61 mm was obtained and in partial edentulous patients 2.69 ± 1.04 mm, resulting in a statistically significant difference (P=0.0092). As for the left central incisor in dentate patients the mean was 1.69 ± 0.65 mm, and in partially edentulous patients 1.07 ± 0.42 mm, not showing a statistically significant difference (P=0.1069) (Table 2).

Evaluation of the distance from the canal inlet to the alveolar ridge

In the evaluation according to the type of dentition of the distance between the canal entrance and the alveolar ridge, in dentate patients the mean obtained was 9.85 ± 2.59 mm, in partially edentulous patients it was 9.29 ± 2.59 mm and in fully edentulous patients it was 5.23 ± 2.94 mm, finding a statistically significant difference (P=0.0036) (Table 2).

Evaluation of the vestibular bone to the incisive canal

In relation to the dentition of the patient, evaluating the length of the vestibular bone in dentate patients the mean was 17.92 ± 3.57 mm, in partially edentulous patients 19.89 ± 2.96 mm and in totally edentulous patients 11.32 ± 5.93 mm, showing a statistically significant difference (P=0.0007). Evaluating the vestibular bone width at coronal level in dentate patients the mean obtained was 7.17 ± 1.63 mm, in partially edentulous patients 7.08 ± 2.43 mm and in totally edentulous patients 4.88 ± 3.50 mm, showing a statistically significant difference (P=0.0559). The vestibular width at the apical level in dentate patients was 12.67 ± 2.39 mm, in partial edentulous patients 13.71 ± 2.25 mm, and in total edentulous patients 13.01 ± 2.10 mm, with no statistically significant difference (P=0.4588). At the mean level in dentate teeth it was 7.55 ± 1.66 mm, partial edentulous 7.76 ± 2.07 mm, and in total edentulous it was 6.19 ± 0.49 mm, where no statistically significant difference was found (P=0.2623) (Table 2).

Evaluation of the palatal bone to the incisive canal

Regarding the palatal bone according to the type of dentition of the patients, at the coronal level in dentate patients a mean of 1.48 ± 0.47 mm was obtained, in partial edentulous patients 1.57 ± 0.42 mm, and in total edentulous patients 1.18 ± 0.70 mm, which did not show a statistically significant difference (P=0.3915). At the apical level in dentate patients it was 5.87 ± 1.62 mm, in partial edentulous it was 6.57 ± 1.19 mm, and in total edentulous it was 3.78 ± 1.86 mm, showing a statistically significant difference (P=0.0169). At the mean level in dentate patients it was 3.71 ± 1.00 mm, in partial edentulous 3.96 ± 0.85 mm, and in total edentulous 2.57 ± 1.39 mm, showing no statistically significant difference (P=0.0654) (Table 2).

Evaluation of the shape of the incisive canal

Concerning the shape of the canal according to the type of dentition of the patients, of the 72 dentate patients, 36 patients (50%) presented hourglass shape, 20 (27.78%) presented funnel shape, 11 (15.28%) cylindrical shape and 5 (6.94%) banana shape. Of the 9 partially edentulous patients, 5 patients (55.56%) presented hourglass shape, 2 patients (22.22%) cylindrical shape, 1 patient (11.11%) funnel shape, and 1 patient (11.11%) banana shape. Of the 4 totally edentulous patients evaluated, 3 (75%) presented hourglass shape, and one patient (25%) presented funnel shape. No statistically significant difference was found (P=0.842) (Table 2).

DISCUSSION

According to Tözüm et al. in 2012, a study was carried out in 933 patients, both edentulous and partially edentulous, where the diameter and length of the incisor canal, the width of the bone anterior to the canal, the length of the bone anterior to the canal, the width of the palatal bone, the length of the palatal bone, the length and root width of the central incisors if present, were evaluated. Where an average incisor canal length of 10.86 ± 2.67mm was obtained, showing that it was shorter in edentulous patients of the anterior maxilla, an average of 2.59 ± 0.91mm, in the present study the average incisor canal length was 12. 82 ±1.94 mm in partially edentulous patients and 9.05 ±2.52 mm in totally edentulous patients, which shows that it is indeed shorter in edentulous patients, however the difference is not significant as in the study of Tözum et al. The canal dimension, height and width of the bone anterior to the canal were greater in male patients, as were the results obtained in the present study[7].

According to the article by Khojastepour et al. in 2017, where only dentate patients were evaluated, and the results they obtained were that the width of the vestibular table over the nasopalatine canal decreases as age increases and shows a negative correlation with age, it was also found that the thickness of the vestibular table is greater in men, comparing with the present study similar results were obtained since in men the mean was 7.96 ± 1.68 mm and in women 6.32 ± 1.69 mm. While the width of the nasopalatine canal opening is positively related to age and increases significantly with increasing age. In this study the most common shape of the canal was the Y type, and the one with the lowest frequency is two separate canals[8].

In the study of Jayasinghe and co-workers in 2020, they evaluated 50 patients of which were 27 females and 23 males, they obtained the following results: the average length of the nasopalatine canal was 12. 142mm with a range of 8.2 - 16.8mm, an average diameter of 3.692mm with a range of 2 - 6mm, the most predominant shape was funnel shaped in 38%, followed by hourglass shape in 26%, banana in 20% and cylindrical in 18%. Comparing with the present study the mean length in females was 9.96 ± 2.31 mm and in males 11.87 ± 2.13 mm; the diameter in mesio-distal direction in females was 3.25 ± 1.06 mm and in males 3.57 ± 1.08 mm; and in terms of shape the most prevalent was hourglass, followed by funnel, cylindrical and banana shape[9].

According to the study of Kim et al. in 2020, in which the study was performed in 167 patients, according to the results obtained the anteroposterior diameter of the incisor foramen is 4.79 ± 1.26 mm which is significantly larger than the mediolateral diameter with 3.29 ± 1.09 mm. The diameter of the incisor foramen in patients with the central incisors was 4.61 ± 1.26 mm in anteroposterior direction and 3.22 ± 0.95 mm in mediolateral direction, which is smaller than in patients without at least one of the central incisors with 5.21 ± 1.15 in anteroposterior direction and 3.52 ± 1.45 mm in mediolateral direction; in general the diameter was smaller in females than in males. Comparing with the present study the mediolateral diameter in dentate patients was 3.42 ± 1.11 mm and in anteroposterior direction was 3.47 ± 1.02 mm, and in patients with the absence of at least one central incisor it was 3.39 ± 0.91 mm in mediolateral direction and in anteroposterior direction 3.34 ± 0.92 mm, where it is demonstrated that the dimensions are smaller in patients where at least one central incisor has been lost. The width of the anterior point from the incisor foramen to the vestibular bone was 7.73 ± 1.37 mm in patients with central incisors, which is significantly larger than in patients without at least one central incisor at 6.89 ± 1.31 mm. The height of the alveolar ridge to the anterior edge of the incisor foramen was 6.42 ± 1.31 mm in patients with central incisors, which is higher than in patients without at least one central incisor at 5.96 ± 1.26 mm. The most common shape of the canal was cylindrical[10].

According to the study by Gil-Marques et al. in 2020, evaluating the shape, direction and dimensions of the nasopalatine canal, the most common shape in both dentate and edentulous patients was the banana and funnel shape; in the present study the most common shape in both dentate and edentulous patients was the hourglass shape, followed by the funnel shape. The canal length in dentate patients was 10.9 ± 2.6 mm, in partially edentulous patients 10.9 ± 3.5 mm and in totally edentulous patients 10.9 ± 2.7 mm, while in the present study in dentate patients it was 10.66 ± 2.35 mm, partially edentulous patients 12.82 ± 1.94 mm and in totally edentulous patients 9.05 ± 2.52 mm. In the buccal bone dimension at the level of the lower part of the canal was 6.8 ± 1.3 mm in dentate patients, 5.1 ± 1.5 mm in partially edentulous patients and 4.7 ± 2.1 mm in totally edentulous patients, comparing with the present study a mean of 7. 17 ± 1.63 mm, in partially edentulous 7.08 ± 2.43 and in totally edentulous 4.88 ± 3.50 mm, where it is shown that the dimension decreases with tooth loss[11].

CONCLUSIONS

Based on the results, it was found that the male patients showed a

greater measurement in the diameter and length of the incisor canal, length and width of the vestibular bone and palatal bone. The diameter of the incisor canal generally tends to be greater in dentate patients and decreases if the patient is totally edentulous. Similarly, the length of the canal, the distance from the canal entrance to the alveolar ridge, the length of the vestibular bone, and the width of the vestibular bone at its coronal level will be considerably smaller in totally edentulous patients. The shape of the incisor canal is not relevant according to the patient's dentition.

It is important to use CBCT as a diagnostic aid prior to surgery in order to avoid trans-operative or post-operative complications, and to perform a safe surgery without injuring nerves or vascular structures.

SCIENTIFIC JUSTIFICATION FOR THE STUDY:

Due to the large number of variations that may exist in the anatomy of the incisor canal, it is of utmost importance to perform a correct preoperative evaluation, to provide an adequate diagnosis and therefore an accurate treatment plan; thus, avoiding damage to nerves or vessels, and subsequent complications such as sensory dysfunction, hemorrhage, and even in the treatment of implants a failure in osseointegration.

MAIN RESULTS:

The variables that showed a statistically significant difference comparing between male and female patients were vestibulo-palatal and incisor foramen diameter, incisor canal length, distance from the canal to the central incisor, coronal and medial width of the vestibular bone; and the width of the palatal bone at apical and mid-level; being greater in male patients. It is important to consider that there is great variety in the size, position and shape of the incisor canal. As a greater diameter is found in male patients, we can anticipate a greater risk during the surgical procedure.

PRACTICAL IMPLICATIONS:

It is important to take anatomical considerations into account to avoid any complications during or after treatment.

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INTEREST CONFLICT

The authors declare no conflict of interest

Table 2. Comparison of variables by type of dentition of the patients.

			Mean	SD	Variance	Test F
Diameter in a coronal slice	Mesio-distal	Dentate	3.42	1.11	1.22	0.34
		Partial edentulous	3.39	0.91	0.82	
		Edentulous	2.96	0.87	0.75	
	Vestibulo-palatine	Dentate	3.47	1.02	1.04	0.20
		Partial edentulous	3.34	0.92	0.85	
		Edentulous	3.72	1.28	1.64	
Diameter	Incisive Foramen	Dentate	3.05	0.94	0.88	0.90
		Partial edentulous	3.46	0.80	0.65	
		Edentulous	3.36	1.27	1.60	
	Middle	Dentate	2.07	0.89	0.79	3.43
		Partial edentulous	2.87	0.69	0.48	
		Edentulous	2.41	1.29	1.67	
	Nasopalatine foramen	Dentate	2.51	1.23	1.52	1.65
		Partial edentulous	3.30	1.15	1.32	
		Edentulous	2.54	1.45	2.11	
Length of the incisive canal		Dentate	10.66	2.35	5.51	4.70
		Partial edentulous	12.82	1.94	3.78	
		Edentulous	9.05	2.52	6.34	
Distance of the canal to the central incisors	Rigth	Dentate	1.70	0.61	0.37	7.17
		Partial edentulous	2.69	1.04	1.09	
		Edentulous	.00	0.00	0.00	
	Left	Dentate	1.69	0.65	0.43	2.66
		Partial edentulous	1.07	0.42	0.17	
		Edentulous	.00	0.00	0.00	
Distance from the canal entrance to the alveolar ridge	Distance	Dentate	9.85	2.59	6.71	6.03
		Partial edentulous	9.29	2.59	6.69	
		Edentulous	5.23	2.94	8.62	

Table 2. Comparison of variables by type of dentition of the patients. *(continuation)*

				Mean	SD	Variance	Test F
Vestibular bone	Length	Dentate		17.92	3.57	12.78	7.87
		Partial edentulous		19.89	2.96	8.77	
		Edentulous		11.32	5.93	35.15	
	Width	Coronal	Dentate	7.17	1.63	2.64	2.99
			Partial edentulous	7.08	2.43	5.92	
			Edentulous	4.88	3.50	12.26	
		Middle	Dentate	7.55	1.66	2.74	1.36
			Partial edentulous	7.76	2.07	4.27	
			Edentulous	6.19	0.49	0.24	
		Apical	Dentate	12.67	2.39	5.71	0.79
			Partial edentulous	13.71	2.25	5.06	
			Edentulous	13.01	2.10	4.40	
Palatine	Width	Coronal	Dentate	1.48	0.47	0.22	0.95
			Partial edentulous	1.57	0.42	0.18	
			Edentulous	1.18	0.70	0.49	
		Middle	Dentate	3.71	1.00	1.00	2.82
			Partial edentulous	3.96	0.85	0.72	
			Edentulous	2.57	1.39	1.93	
		Apical	Dentate	5.87	1.62	2.64	4.29
			Partial edentulous	6.57	1.19	1.42	
			Edentulous	3.78	1.86	3.47	

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