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ORIGINAL ARTICLE

Measurements of Dimensions of Nasopalatine Canal Using Cone Beam Computed Tomography in Patients Reporting to A Local Tertiary Care Dental Hospital in Lahore

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ABSTRACT

Objective: To measure the mean length and width of NPC in patients reporting to Fatima Memorial hospital Lahore, for implant surgery.

Methods: This crossectional study was conducted at Department of Periodontology, Fatima Memorial Hospital, Lahore. Fatima Memorial Hospital is a tertiary care dental hospital affiliated with University of Health Sciences. After taking informed written consent history was taken, clinical examination was done and CBCT from SIRONA CBCT machine will be taken to assess the outcome i.e the mean length and width of NPC.

Result: Total of 72 patients requiring CBCT for dental procedures were included. 38 patients were males (52.8%) & 34 patients were females (47.2%) with the mean age of 40.944+7.507 years. The mean length and width of Nasopalatine canal (NPC) was 8.787+1.534 mm and 3.919+0.738 mm respectively.

Conclusion: Significant differences in nasopalatine canal length and width were observed among the patients and CBCT was useful in determining nasopalatine canal length and width before implant placement

Key words: Cone-Beam Computed Tomography; nasopalatine canal, length, width

INTRODUCTION

Maxillary anterior segment is a common region prone to trauma and subsequent tooth loss, which often requires surgical interventions including implant placement.[1] Implant procedures are considered as the method of choice for replacing missing teeth. Dental implants have gained popularity amongst patients and dentists primarily due to better functional and aesthetic restorations compared to previous prosthodontics measures.[2] A safe distance between critical anatomical landmarks and dental implant is necessary for a successful and stable implant treatment.[2] During implant placement in the anterior region of the maxilla, attention should be paid to the atrophy of the alveolar bone following the loss of incisors and also to the morphology and position and dimensions of the nasopalatine canal.[1]

The nasopalatine canal (NPC) is present in the anterior maxilla in close proximity to the central incisors. The oral aperture of the NPC lies in the anterior maxilla, just dorsal to the roots of the maxillary central incisors and the funnel-shaped opening to the oral cavity is defined as the incisive foramen or fossa.[3] The canal on its way to nasal cavity and terminate in the floor of the nasal cavity as Stenson foramen.[4] NPC runs parallel to the maxillary central incisors and transmits the nasopalatine vessels and nerves, branches of the maxillary artery, and the trigeminal nerve; and is surrounded by a thick layer of cortical bone.[5]

Because of its proximity to the maxillary incisors, the possibility of surgical invasion of the incisive canal during dental procedures has been reported, and this can result in non-osseointegration of dental implants or sensory loss. Although the overall anatomy of the incisive canal is well defined, its precise location in relation to the maxillary incisors and size in individuals of different ages and gender is not well documented.[5]

In order to minimize complications following implant placement in the incisor area, three dimensional (3D) configuration of nasopalatine canal, its position in relation to the surrounding structures, alveolar bone morphology, and incisors morphology should be evaluated carefully. Radiographic evaluation before surgery also determines bone quality and quantity in the selected area and is a useful guide for selecting the proper site, number, size, and angle of implants.[6]

Conventional radiographic techniques such as panoramic and intraoral x-rays do not provide required information about buccolingual width of the alveolar bone, anatomical structures, condition, or the 3D structure of the selected implant site.[6]

Application of cross-sectional imaging using cone-beam computed tomography (CBCT) in implant dentistry has rapidly grown in the recent past. CBCT is a special type of radiographic tool that has increased accuracy, higher resolution, lower radiation dose, and reduced cost for patients compared with other volumetric imaging modalities for the assessment of mineralized tissues of maxillofacial area, CBCT provides three dimensional (3D) information of teeth, nerve pathways and bone in a single scan and helps is making a better diagnosis and treatment plan.[7] There are no obvious differences seen between linear measurements on CBCT and direct measurements of maxillofacial structures, which is the gold standard.[6] Along with age and gender based variations, racial variations have also been seen and reported in the dimensions of NPC.[3] According to a study conducted by Fateme Salemi., et al. the mean length of NPC in sagittal section of CBCT was measured to be 11.26 mm in women and 12.64 mm in men. [1] In another study by Khojastepour L., et al. the mean width of NPC at incisive foramen in

sagittal section of CBCT was measured to be 3.40 ± 1.08 mm for men and 2.97 ± 0.91 mm for women.[2]

Mean length of NPC in males is 11.46 ± 2.86 mm and that for females is 9.37 ± 2.24.[2]

METHODOLOGY

This study was conducted at Department of Periodontology, Fatima Memorial Hospital, Lahore. Duration of study was six months from 15th Sep 2019 to 15th Mar 2020. In this study a total of 72 patients aged 18-70 years of both genders having one or both central incisors, no impacted teeth and no developmental or acquired radiographic deformity in premaxilla area requiring CBCT examination for other dental purposes were included in this study. Subjects who were pregnant or lactating mothers, had radiolucency, residual roots, dental implants or suspected nasopalatine cysts in the area of interest were excluded from the study. History followed by clinical examination ensured inclusion of patient who meet the inclusion and exclusion criteria. A single radiographer took all CBCT from SIRONA CBCT machine. After CBCT images were taken, the length and diameter of NPC was measured a single examiner. Data was entered and analyzed in SPSS version 25. Descriptive analysis was performed on all the variables. Categorical variables like gender were presented in form of frequency and percentages whereas quantitative variable like age were presented in form of mean (SD) depending upon the distribution of the variable.

Data was stratified according to gender and age, independent sample t-test test was applied depending upon post stratification distribution of data. P-value less than 0.05 was considered significant

RESULT

A total of 72 patients requiring CBCT for dental procedures were selected to conduct this study. The mean age of 40.944+7.507 years. In our study 38 patients were males (52.8%) & 34 patients were females (47.2%). The mean length of Nasopalatine canal (NPC) was 8.787+1.534 mm. The mean width of NPC was 3.919+0.738 mm.

Table-I| Descriptive values of variables

Gender	Frequency(%age)
Male	38(52.8%)
Female	34(47.2%)
	Mean±SD
Age	40.944±7.507
Length of NPC(mm)	8.787±1.534
Width of NPC(mm)	3.919±0.738

There was significant difference noted between the mean length of NPC and width of NPC with p-value of 0.001

Table 2: Comparison of mean length of Nasopalatine canal (NPC) and mean width of Nasopalatine canal (NPC):(n=72)

	Mean±SD	t-test	Sig.
Length of NPC (mm)	8.787+1.534	20.399	0.001
Width of NPC (mm)	3.919+0.738		

The results of the study there was significant difference of mean length and width of NPC was noted with the age (t= & gender.

Table-6: Comparison of mean length of Nasopalatine canal (NPC) and mean width of Nasopalatine canal (NPC) according to age: (n=72))

Age	Length of NPC (mm)	Width of NPC (mm)
18-44	9.769+1.354	3.561+0.550
45-70	7.627+0.693	4.342+0.712
t test	8.213	-5.243
Sig.	.001	.001

Table-7: Comparison of mean length of Nasopalatine canal (NPC) and mean width of Nasopalatine canal (NPC) according to gender: (n=72))

Gender	Length of NPC (mm)	Width of NPC (mm)
Male	8.681+1.573	4.405+0.630
Female	8.905+1.503	3.375+0.388
t test	-0.617	8.221
Sig.	0.539	0.001

DISCUSSION

Maxillary anterior teeth are of outmost aesthetic importance, especially upon smiling. Their angulations and location determine the midface profiles of the individual. These teeth are also responsible for incising. Unfortunately, they are most vulnerable teeth to trauma because of their exposed location. Since they are also thin planar teeth, considerable proportions of their structures can be damaged by caries in a short time or through iatrogenic assaults during dental treatments. All these may result in their loss prematurely. Currently, implants are the broadest accepted method to rehabilitate tooth loss in anterior maxilla, but this procedure faces some anatomic limitations in the area. NPC can occupy up to 58% of buccal bone plate width, which should receive and support the implants.[8] Adequate information about dimensions and 3-dimensional configuration of this canal is critically needed for comprehensive planning of an implant treatment in anterior maxilla. Incautious operations may damage the neurovascular content of NPC, resulting in anaesthesia, haemorrhage, and failure of osseointegration. Three-dimensional CBCT imaging can reveal the anatomic characteristics and variation of NPC precisely.[9,10,11]

CBCT imaging is increasingly applied for pre-implant radiographic evaluations. This technique of imaging is based on a cone-shaped x-ray source and a two dimensional detector, which preparing data in a single rotation around the patient head. Time and patient dose are considerably decreased comparing with conventional CT scans. [11,12] This study performed to measure the mean length and width of NPC in patients undergoing dental procedures using CBCT.

In our study the mean length of Nasopalatine canal (NPC) was 8.787+1.534 mm, while the mean width of NPC was 3.919+0.738 mm. In Friedrich et al[13] study The mean length of NPC was 11.15 mm in the present study. According to current radiological reports on NPC morphology, the length of the canal is expected to range from 8 to 13 mm[14]. Recently, Al-Amery et al. reported a mean NPC length of 16.33±4.43 mm and a slight but significant difference between males and females.[15]

According to a study conducted by Fateme Salemi., et al[16] the mean length of NPC in sagittal section of CBCT was measured to be 11.26 mm in women and 12.64 mm in men.[16] In another study by Khojastepour L., et al. the mean width of NPC at incisive foramen in sagittal section of CBCT was measured to be 3.40 ± 1.08 mm for men and 2.97 ± 0.91 mm for women.[2] Mean length of NPC in males is 11.46 ± 2.86 mm and that for females is 9.37 ± 2.24.[2]

Measurement of the canal width is important to define intraluminal pathologies[17]. A diameter of up to 6 mm is suggested to be within the normal range; diameters larger than 10 mm are suspected to indicate a pathological process, in particular nasopalatine duct cyst.[17]

Along with age and gender based variations, racial variations have also been seen and reported in the dimensions of NPC.[18] In our study males have wider NPC than females in all the age groups, which is similar to other studies in which males had higher buccal bone thickness than females, both concerning length and width of the bone anterior to the NPC[8]. These findings were confirmed in other studies, but without statistically significant difference[19].

In our study with the age the length of NPC decreases and width increases in both males & females, in contrast to Khojastepour et al[2] study in which the buccal bone plate width in dentate individual decreases with age.

The limitation of our study was single centre study, smaller sample size. Further studies with larger sample sizes are required.

CONCLUSION

Significant differences in nasopalatine canal length and width were observed among the patients and CBCT was useful in determining nasopalatine canal length and width before implant placement

REFERENCES

1. Salemi F, Moghadam FA, Shakibai Z, Farhadian M. Three-dimensional assessment of the Nasopalatine canal and the surrounding bone using Cone beam computed tomography. J Periodontal Implant Dent 2016;8(1):1–7
2. Khojastepour L., Haghnegahdar AA, Keshtkar M. Morphology and dimensions of Nasopalatine canal: a radiographic analysis using Cone beam computed tomography. J Dent Shiraz Univ Med Sci., 2017 December; 18(4): 244-250.
3. Friedrich RE, Laumann F, Zrnc T, Assaf AT. The Nasopalatine canal in adults on cone beam computed tomograms a clinical study and review of the literature. in vivo 29: 467-486 (2015)
4. Gupta J, Ali S. Cone beam computed tomography in oral implants. National Journal of Maxillofacial Surgery. 2013;4(1):2.
5. Cho E, Kim S, Choi Y, Kim K, Chung C. Morphologic evaluation of the incisive canal and its proximity to the maxillary central incisors using computed tomography images. The Angle Orthodontist. 2016;86(4):571-576.
6. Panjnoush M, Norouzi H, Kheirandish Y, Shamshiri AR, Mofidi N. Evaluation of morphology and anatomical measurement of Nasopalatine canal using Cone beam computed tomography. Journal of Dentistry (Tehran, Iran). 2016;13(4):287-294.
7. Rios H, Borgnakke W, Benavides E. The use of Cone beam computed tomography in management of patients requiring dental implants: An American Academy of Periodontology Best Evidence Review. Journal of Periodontology. 2017;88(10):946-959.
8. Acar B, Kamburoğlu K. Morphological and volumetric evaluation of the nasopalatinal canal in a Turkish population using cone-beam computed tomography.Surg Radiol Anat. 2015; 37: 259–265.
9. 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: 396–402.
10. Jacobs R, Mraiwa N, Van Steenberghe D, Sanderink G, Quirynen M. Appearance of the mandibular incisive canal on panoramicradiographs. Surg Radiol Anat. 2004;26: 329–333.
11. Ávila-Ruiz F, Ávila-Ruiz F, Cuello S, Hermo-Silla A, Aravena P. Sexual dimorphism in the incisive canal in humans: A literature review. Journal of Oral Research. 2014; 3: 57–61.
12. Fernández-Alonso A, Suárez-Quintanilla JA, Muinelo-Lorenzo J, Bornstein MM, Blanco-Carrión A, Suárez-Cunqueiro MM. Three-dimensional study of nasopalatine canal morphology: a descriptive retrospective analysis using cone-beam computed tomography. Surg Radiol Anat. 2014; 36: 895–905.
13. Friedrich RE, Laumann F, Zrnc T, Assaf AT. The Nasopalatine Canal in Adults on Cone Beam Computed Tomograms–A Clinical Study and Review of the Literature. in vivo. 2015 Jul 1;29(4):467-86.
14. 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 79: 1659-1662, 2008.
15. Al-Amery SM, Nambiar P, Jamaludin M, John J, Ngeow WC: C one beam computed tomography assessment of the maxillary incisive canal and foramen: considerations of anatomical variations when placing immediate implants. PLoS One 10: e0117251, 2015
16. Salemi F, Moghadam FA, Shakibai Z, Farhadian M. Three-dimensional assessment of the Nasopalatine canal and the surrounding bone using Cone beam computed tomography. J Periodontal Implant Dent 2016;8(1):1–7
17. Mraiwa N, Jacobs R, van Cleynenbreugel J, Sanderink G, Schutyser F, Suetens P, va n Steenberghe D, Quirynen M: The nasopalatine canal revisited using 2D and 3D CT imaging. Dentomaxillofac Radiol 33: 396-402, 2004
18. Friedrich RE, Laumann F, Zrnc T, Assaf AT. The Nasopalatine canal in adults on cone beam computed tomograms a clinical study and review of the literature. in vivo 29: 467-486 (2015)
19. Fernández-Alonso A, Suárez-Quintanilla JA, Muinelo-Lorenzo J, Bornstein MM, Blanco-Carrión A, Suárez-Cunqueiro MM: Three-dimensional study of nasopalatine canal morphology: a descriptive retrospective analysis using cone-beam computed tomography. Surg Radiol Anat 36: 895-905, 2014