A RETROSPECTIVE STUDY ON NASOPALATINE CANAL'S SHAPE, DIRECTION OF COURSE AND NUMBER OF OPENINGS IN CONE BEAM COMPUTED TOMOGRAPHY

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Abstract:
Aim: The aim of the present study is to examine the Nasopalatine (NPC) morphology on cone beam computed tomography (CBCT) images of the individuals in sagittal and axial plane.
Material and Methods: A retrospective study was conducted on NPC using cone beam computed tomography of 60 subjects. NPC was measured and its shape and direction-course were classified using sagittal imaging and the number of openings was determined using axial images.
Result: The most prevalent canal shape was found to be funnel shape (28.3%).There was also a significant correlation between male and female in shape was found cone shaped (36.7%) and funnel shape (36.7%) respectively.The most common type was slanted-curved in 22 (36.7%) cases. In axial plane 93% of the individuals had single NPC, while 7% had double NPCs and only 1 case had triple NPCs.
Conclusion: The latest study adds to the literature's description of the canal's anatomical structure. The study also reveals that the anatomy and morphology of the NPC vary significantly. As a result, three-dimensional study of this structure is critical for easing surgical care and avoiding potential problems.

Keywords: Nasopalatine canal, Nasopalatine foramen, Shape, Direction, Number of openings.

Introduction: The nasopalatine canal connects the nasal cavity to the palate and is positioned in the middle of the anterior maxilla, posterior to the central maxillary incisors.The canal's opening is funnel-shaped and known as the (incisive foramen), whereas the canal in the nasal cavity is divided into two canaliculi with an opening known as the (nasal foramen) (foramina of Stenson). The nasopalatine (incisive) nerve, the terminal branch of the descending nasopalatine artery, fibrous connective tissue, fat, and small salivary glands are all found in the canal. [1] [2][3] Nowadays, people consider aesthetics to be a crucial component. Dental implants have emerged as a novel therapeutic option for edentulous patients to replace missing teeth and restore both function and appearance.

Although dental implants are becoming the treatment of choice, there are still certain difficulties associated with implant placement. [4] Previous attempts at morphometry of NPC using two-dimensional radiography yielded limited results. Due to inconsistencies in demographic data and discrepancies between healthy and unwell individuals, anthropometric studies are difficult to compare with patient populations. Several research have looked at these traits with few aspects in diverse globe groups in recent years. [5] [6] [7] The development of cone-beam computed tomography has revolutionized our understanding of NPC anatomic and morphometric diversity (CBCT). CBCT is a type of sophisticated craniofacial imaging that generates cross-sectional pictures that help with three-dimensional views of the maxillofacial structures. It is a significant diagnostic tool in the clinical evaluation of

patients. [8] [9][4] Despite this, only a few studies have used CBCT to evaluate the anatomical and morphometric aspects of NPC in the Indian population and study their relationship with demographic variables. [5] [6]

Material and Methods: A total of 60 CBCT Scans with no pathology were randomly chosen from 30 female and 30 male participants aged 15–65 years.

PAPAYA 3D PLUS imaging machine with the following imaging protocols-field of view: 5*10cm, voxel size: 0.18 mm, kilo voltage: 80-90kvp and milliampere: 5-10 Ma was used. TRIANA software version 2.5.11.2. programmed analyzed the CBCT scans of patients who were scanned at Karnavati School of Dentistry.

Exclusion criteria: The CBCT images of cases with NPC cyst, tumor, developmental, metabolic, inflammatory diseases of jaw which could seriously affect the alveolar bone and nasopalatine canal dimensions were not included in the study.

CBCT Images with insufficient, inconsistent, or confusing information about any variable, artefact images that would prevent the detection and measurement of reference points.

Inclusion criteria:

CBCT Scans of patient with age >15 -<65 years.

Patients with dentulous, edentulous or partially edentulous maxilla.

High-quality reconstructed images without artifacts. [10]

NPC morphology was characterized in two planes: sagittal, and axial plane.

In Sagittal plane, the NPC was assessed concerning the classification of Song et al. [8] for its sagittal direction-course: **(1)** vertical-straight **(2)** vertical-curved **(3)** slanted-straight **(4)** slanted-curved **(Figure 1)**. A total of five groups were measured in sagittal sections from cone-beam computed tomography image: the length of the nasopalatine canal created: **(1)** hourglass **(2)** cylindrical **(3)** cone **(4)** funnel **(5)** other shapes which included kink, spindle, banana. **(Figure 2)**In axial plane, the number of openings of NPC was assessed and classified as one, two and three. **(Figure 3)**
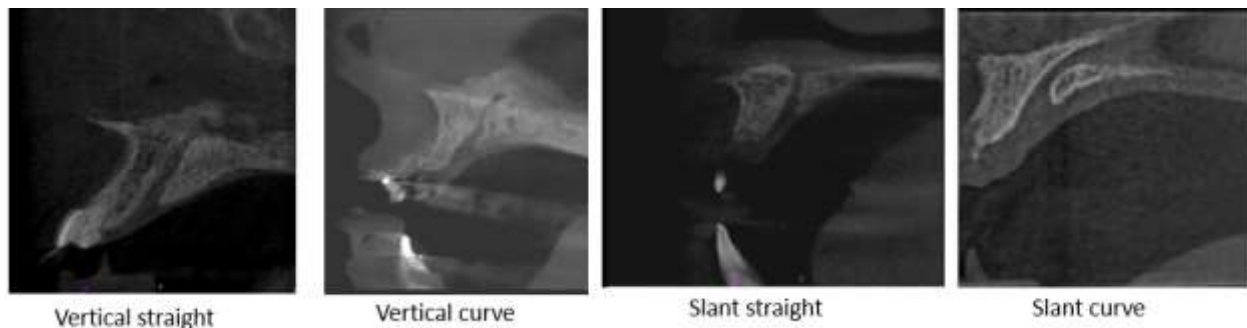

Vertical straight   Vertical curve   Slant straight   Slant curve

Figure 1: Course of direction of NPC in Sagittal Section
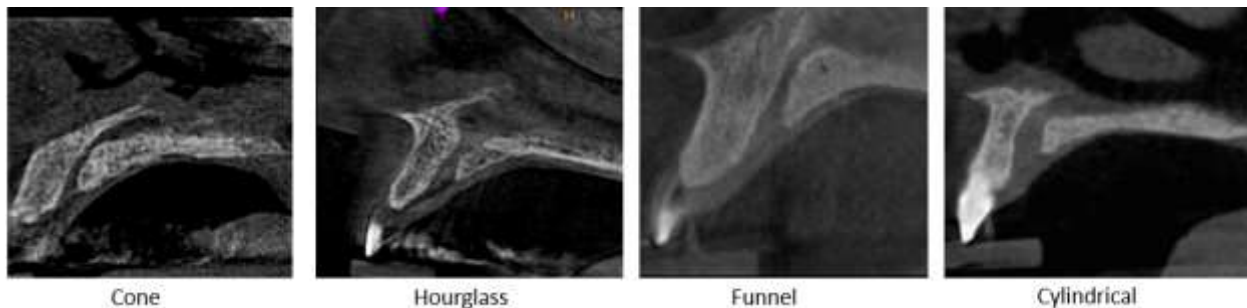

Cone   Hourglass   Funnel   Cylindrical

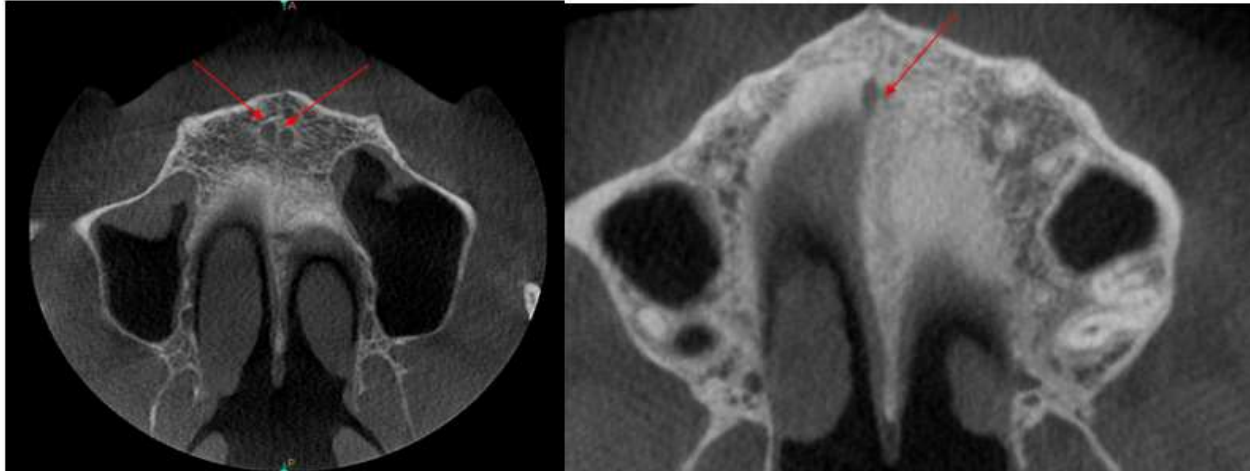**Figure 2: Shape of the NPC in Sagittal Section**

Figure 3: Number of NPC Openings in Axial Section

Result: Total 60 patients were analyzed out of which 30 were male and 30 females. The statistical analysis was performed using the statistical software package SPSS (Chicago, IL, USA) version 21.0 for MS Windows & $P \leq 0.05$ was considered statistically significant. In sagittal plane, the most prevalent canal shape was found to be funnel-shaped 17(28.3%), followed by cone-shaped in 16 (26.7%) cases, followed by cylindrical in 10 (16.7%), followed by hourglass in 7 (18.3%), followed by others in 6 (10%). There was also a significant correlation between male and female in shape was found cone shaped (36.7%) and funnel shape (36.7%) respectively. The p value was found to be 0.014 which suggest significance. [Table:1]

In terms of the sagittal direction-course of NPC, the most common type was slanted-curved in 22 (36.7%) cases, followed by vertical-straight and vertical curved in 14 (23.3%) cases, slanted-straight in 10 (16.7%) cases. The sagittal direction and course of the canal revealed no significant difference between genders (p = 0.205).According to Fischer's test value was 0.205 which signifies no significant relation between gender and direction of course of NPC. [Table: 2]

In axial plane, the prevalence's of nasoplatine canal foramen were the following: 93% of the individuals had single NPF, while 7% had double NPFs and only 1 case had triple NPFs. There was no significant difference in number of openings of NPF between male and female as p value was 1.00 which suggests no significant relationship between gender and number of openings of NPC. [Table:3]

Table 1: Shape of Nasoplatine Canal

Gender wise distribution of shape of NP									Fischer's exact test			Cramer's V	
			SHAPE OF NP							Chi square value	df	P value	Value	P value
			HOURGLASS	CONE	FUNNEL	CYLINDRICAL	OTHER	Total						
Gender	Male	Count	4	11	6	3	6	30					
		% within Gender	13.3%	36.7%	20.0%	10.0%	20.0%	100.0%						
		Adjusted Residual	-1.0	1.8	-1.4	-1.4	2.6		12.029	-	0.014	0.450	0.014
	Female	Count	7	5	11	7	0	30					
		% within Gender	23.3%	16.7%	36.7%	23.3%	0.0%	100.0%						
		Adjusted Residual	1.0	-1.8	1.4	1.4	-2.6						
Total		Count	11	16	17	10	6	60					

% within Gender	18.3%	26.7%	28.3%	16.7%	10.0%	100.0%					

Table 2: Shows Direction of Course of NPC

ENDER * NO OF OPENINGS Cross tabulation							Fisher's exact test
			NO OF OPENINGS		Total		P value
			One Opening	Two Opening			
GENDER	Male	Count	26	4	30		
		% within GENDER	86.7%	13.3%	100.0%		
		Adjusted Residual	-.4	.4			1.00
	Female	Count	27	3	30		
		% within GENDER	90.0%	10.0%	100.0%		
		Adjusted Residual	.4	-.4			
Total		Count	53	7	60		
		% within GENDER	88.3%	11.7%	100.0%		

Discussion: Maximum aesthetic value is placed on the maxillary anterior teeth, particularly when smiling. Their angulation positions influence the person's midface profile. Additionally, these teeth are used for incising. Unfortunately, due to their exposed position, these are the teeth that are most susceptible to harm. Since they are thin flat teeth, significant sections of their structures may be destroyed quickly by caries or by iatrogenic injuries sustained during dental procedures. All of these may result in their loss prematurely. The most widely acknowledged option for replacing missing teeth in the front maxilla is currently implants, but there are certain anatomical restrictions in the region. Complete planning of an implant therapy in the front maxilla requires the knowledge of the dimensions and three-dimensional configuration of this canal. Unsafe procedures could cause the neurovascular content of the NPC to become damaged, which could lead to, anesthesia, hemorrhage and osseointegration failure. Three dimension CBCT imaging can precisely show the anatomical features and variety of NPC.

Table 3: Shows Number of Openings of Canal in Axial Section

Gender * DIRECTION OF COURSE OF NPC								Fischer's exact test		
			DIRECTIONOFCOURSEOFNP				Total	Chi square value	df	P value
			VERTICAL STRAIGHT	VERTICAL CURVED	SLANTED STRAIGHT	SLANTED CURVED				
Gender	Male	Count	5	6	4	15	30			
		% within Gender	16.7%	20.0%	13.3%	50.0%	100.0%			
		Adjusted Residual	-1.2	-.6	-.7	2.1				
	Female	Count	9	8	6	7	30	4.685		0.205
		% within Gender	30.0%	26.7%	20.0%	23.3%	100.0%			
		Adjusted Residual	1.2	.6	.7	-2.1				
Total		Count	14	14	10	22	60			
		% within Gender	23.3%	23.3%	16.7%	36.7%	100.0%			

In sagittal plane, studies on the variations in canal shape have been described in the literature, but no standard classification was discovered. Hourglass, cylindrical, funnel, and banana shapes of canals were categorized into four categories in sagittal planes by Fernandez-Alonso et al.[11] and Gönül et al. [12], nevertheless, Liang et al. [9] only separated into two groups: cylindrical and conical. Etoz and, Sekerci et al. [13], Işman [14], Hakbilen [12], and Magat [15] assessed the canal's six different groupings of shape (cone, cylinder, banana, tree branches, funnel, and so forth) in their studies. These classifications, nonetheless, fell short of accurately describing the NPC's shape.

After analyzing every canal shape described in the literature, a new categorization was created. It was discovered that the rate of the spindle forms and "other" groups were seen at the lowest rated, 3.8 percent and 3.1 percent respectively, while the funnel shapes (29.1 percent) and hourglass shapes (16.3 percent) were found at the greatest rate.

The majority of research in the literature [16] [14] [15] [17] [13] [7] agree with these findings. The findings contrast with those of research by Tözüm et al. [18], Hakbilen and Magat [15] and Gönül et al. [12], though.

We propose that these variances might result from differences in racial characteristics, sample size, and classifications.

In contrast to Song et al. [8], who showed that the majority of canals were vertical in shape, our findings for sagittal direction-course show that slanted canals are more common than vertical ones. Additionally, the current findings for straight versus curved canal types differed from those of these studies. It might be because there were less participants in their study [8].

In axial plane, the variants of the canal were classified concerning the number of NPC.

Most NPC differences were reported at the nasal floor level. On the basis of the axial section, some studies [14] [19] [9] [7] [20] divided nasopalatine foramina into four groups, while others [16] [13] evaluated them into three groups. They made no mention of the quantity of sharp foramina, though.

Additionally, Sicher [21] discovered that a nasal aperture may originate from a single foramen or as many as six different foramina. Furthermore, contrary to popular opinion, the NPC was assessed by Al-Amery et al. [22] and Song et al. [8] from the middle section to the level of the nasal opening. This study counted the number of canal openings in the nasal and palatal levels, evaluating these levels collectively to establish the axial classification.

Conclusion: The NPC exhibits a wide range of shape and direction. Rehabilitating the anterior maxilla is highly clinically significant in terms of both function and appearance.

This study presents novel data about the classification of canal shape and variations in morphometric parameters. Different studies has increased knowledge of this anatomic structure and the use of cross-sectional imaging for better surgical outcomes and to lower surgical complications because the current results highlighted the NPC's diversity in terms of various parameters. The study should be done on wide range of patients to support the above results.

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