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# A retrospective radiographic study of morphology and length of nasopalatine canal using cone beam computed tomography

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**Abstract**
The incisive foramen, also called anterior palatine foramen, or nasopalatine foramen is a funnel-shaped opening in anterior maxilla (hard palate) which opens immediately behind the incisor teeth through which nasopalatine blood vessels and nerves passes. The incisive foramen is continuous with the incisive canal. The incisive foramen receives the nasopalatine nerves from the floor of the nasal cavity along with the sphenopalatine artery supplying the mucous membrane covering the hard palate of the mouth. Two dimensional radiographic images provides less accurate anatomical details but cone beam computed tomography (CT) is a specialized radiographic imaging technique that used to produce three dimensional (3-D) images of teeth, soft tissues, nerve pathways and bone in a single scan usually done when regular dental x-rays images are not sufficient. This study is design to analyze the shape and size of the nasopalatine duct in both the gender using CBCT in North Indian population.

**Keywords:** Cone- beam computed tomography (CBCT), incisive canal, nasopalatine canal (NPC)

## Introduction
The nasopalatine canal (Incisive canal) is situated in the anterior maxilla which is anatomically a long slender passage that connects the palate to the floor of the nasal cavity and intraoral situated posterior to the central incisor teeth and in the nasal cavity as the foramina of Stenson. The contents of the canal are a branch of greater palatine artery, nasopalatine artery, and nasopalatine nerve that supplies to the premaxilla region [1, 2].

Nasopalatine canal has a prominent role during dental treatments such as extraction and implant placement as these procedures may cause intraoral trauma. A proper image of the incisive canal and foramen before and after treatment is very important as it further decides the success of treatment [3].

Various radiographic techniques were used to locate the nasopalatine canal like intraoral periapical, occlusal radiographs and panoramic radiography. However these are two-dimensional imaging that provides less anatomical details. Computed tomography [CT]) is now widely replaced by cone beam CT (CBCT) that provides valuable three-dimensional imaging with less radiation exposure and high resolution. Moreover CBCT technology has facilitated 3D evaluation of bone quantity and exact position of NPC in the anterior maxilla [4].

## AIM
The aim of the study is to analyze the shape and size of the nasopalatine duct in both the gender using CBCT in North Indian population.

## Materials and Methods
This retrospective study includes 80 CBCT scans taken from a CBCT center in Delhi, India. The age of included patients were range from 20-80 yrs. All the scans were evaluated properly so that each and every scan must show complete nasopalatine canal in axial, coronal and sagittal sections. Two observers who were specialized in maxillofacial radiology analyze the data and collected them separately.

Patient with pathology of incisive canal like cyst, tumors, fracture of middle face, impacted teeth near to canal were not taken into final selected data.

CS-3D (care stream) software was used to evaluate the images and linear measurements of nasopalatine canal. Length of the canal in sagittal section of CBCT was recorded which extended from floor of the nasal fossa to the level of the hard palate with the help of linear measurement tools given in software. (Figure 1)

Shape of the canal was observed in the sagittal section and classified as:-
- A cylindrical shape [Figure 2a]
- A funnel shape [Figure 2b]
- An hourglass shape [Figure 2c]
- A spindle shape [Figure 2d]

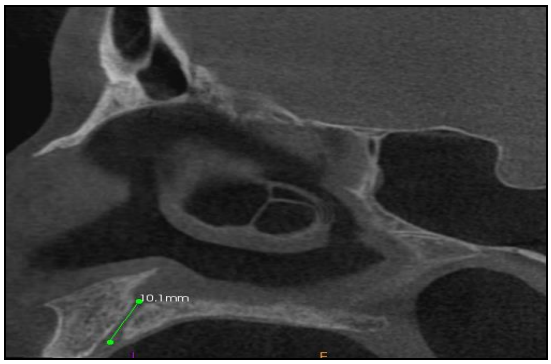



**Fig 1:** Figure showing length of canal in mm

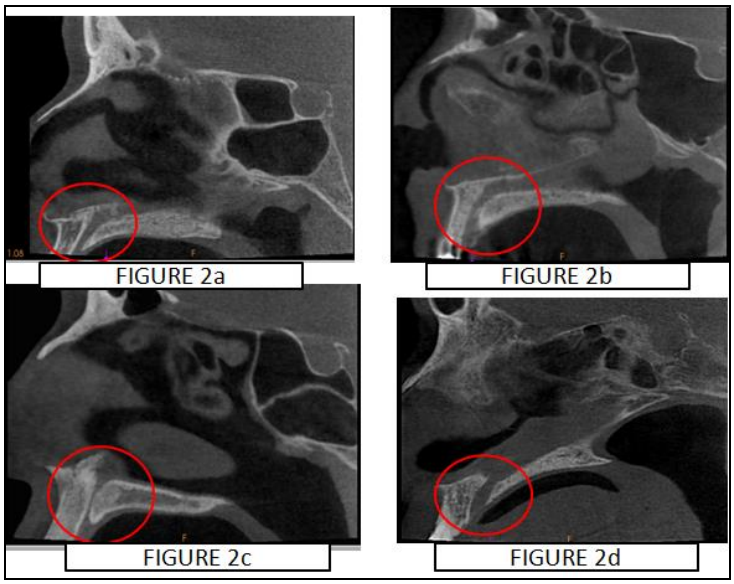



**Fig 2:** Showing different shapes of canal in saggital section

## Results

The cylindrical shape of NPC was the most common which was recorded in 65% of cases of the total sample size and the least common was the spindle shape that was seen in 3.75% of cases. The funnel shape and hourglass shape of canal was recorded in 20% and 11.25% of total cases respectively (Table 1). The numbers of different morphology of NPC canal in each gender is given in Table 2 and Graph 1.

The length of the NPC was measured between the level of the nasal fossa and the level of the hard palate along the long axis of the canal [Figure 1]. It ranged from 7.02 mm to 17.16 mm in male with a mean of 12.04 mm and from 6.59 mm to 15.86 mm in female with a mean of 10.76 mm. This shows that length of the NPC is relatively greater in male than in female (Table 3).

**Table 1:** Shape of canal

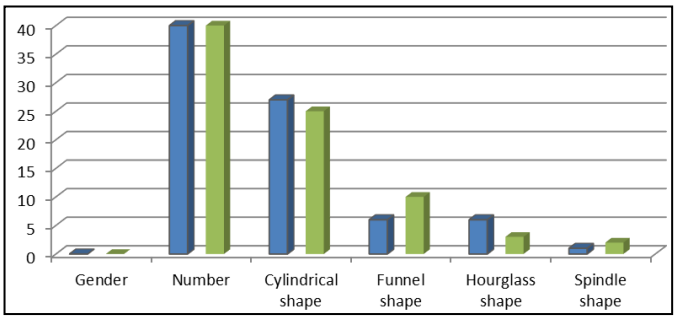
| Shape of canal | Cylindrical shape | Funnel shape | Hourglass shape | Spindle shape |
|---|---|---|---|---|
| Number | 52 | 16 | 9 | 3 |
| percentage | 65% | 20% | 11.25% | 3.75% |

**Table 2:** Gender wise shape of canal

| Gender | Number | Cylindrical shape | Funnel shape | Hourglass shape | Spindle shape |
|---|---|---|---|---|---|
| Male | 40 | 27 | 6 | 6 | 1 |
| | | 67.5% | 15% | 15% | 2.5% |
| Female | 40 | 25 | 10 | 3 | 2 |
| | | 62.5% | 25% | 7.5% | 5% |

**Table 3:** Length of canal

| Gender | Number | Min length (mm) | Max length (mm) | Mean (mm) |
|---|---|---|---|---|
| Male | 40 | 7.02 | 17.16 | 12.04 |
| Female | 40 | 6.59 | 15.86 | 10.76 |




**Graph 1:** Color code (Blue-Male and Green-Female)

## Discussion

There is close proximity of anterior maxillary teeth and nasopalatine canal. Because of wide range of diversity in morphology, anatomy and size of nasopalatine canal care should be taken while placing the implants or any other surgical procedure which further helps in preserving the contents of the duct, reducing the risk of paresthesia of the anterior maxilla. CBCT is the recent and most accurate radiographic modality with less radiation exposure and three dimensional projection of images helps to understand the canal morphology better.

The results of present study recorded the four anatomical shapes of NPC in sagittal CBCT section. The cylindrical shape of NPC was the most common type and spindle shape was least common type. The study done by Thakur *et al*, (2013) [5]. and Misra *et al*, (2018) [6] also recorded the cylindrical shape the most common type of morphology. Our results are also consistent with the studies of Mardinger *et al*, [7] Tözüm *et al*, [8] Fernández- Alonso *et al*, [9] and Nasseh *et al*, [10] who found that the cylindrical shape of NPC was the most frequent.

In contrast, the study done by Fukuda *et al*. in 2015 reported that the funnel shape was most common (50%) [11]. with funnel shaped, there is a risk in implant placement as it may cause perforation of canal and damaging the nasopalatine nerves and arteries.

The mean length of the NPC in male was 12.04 mm and in female it was 10.76 mm. Our results are consistent with the studies done by Kajan *et al* [12] Yaser *et al* [13] which was 12.84 ± 2.88, 12.85 ± 2.63, respectively. The length of canal in male is statistically significant larger than the female. This finding is in accordance to Thakur *et al* [15], Tozum *et al* [8], Kajan *et al*, [12] and Yaser *et al*. [13].

## Conclusion

The greater length of the NPC in the males may be because of the relatively larger craniocaudal dimension of the face in the males as compared to the females. The most common shape of canal was cylindrical type. With the introduction of CBCT in dentistry provides detailed knowledge of anatomical structures and overcome the drawbacks of 2D images. CBCT imaging is increasingly applied for pre-implant radiographic evaluations. Complete knowledge of morphological diversity of NPC is clinically important in performing surgical procedure of anterior maxilla and further reduced complications.

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