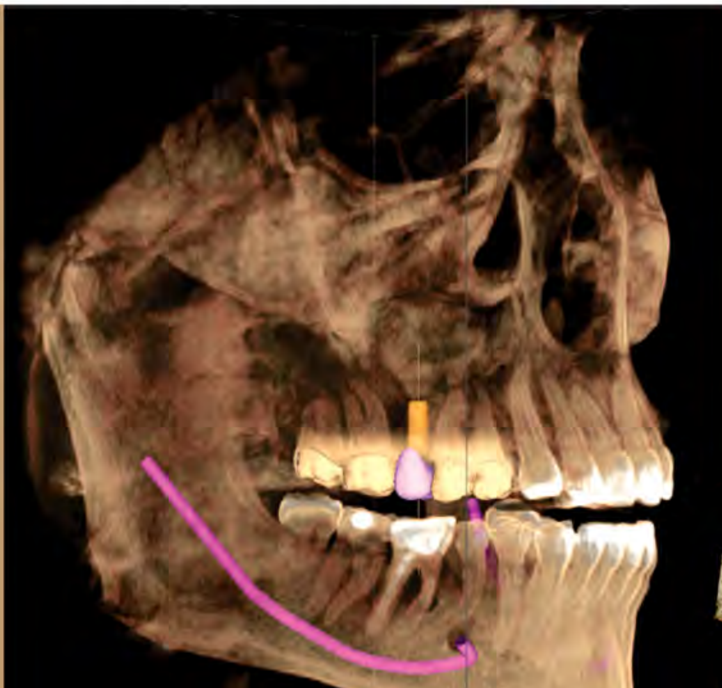
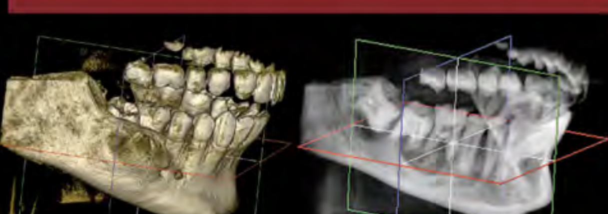
JAYPEE

CONE BEAM COMPUTED TOMOGRAPHY

A Clinician's Guide to 3D Imaging





Prashant P Jaju

Foreword
Stuart C White

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4
Chapter

Anatomical Landmarks on Cone Beam Computed Tomography

Sushma P Jaju

INTRODUCTION

Humans can diagnose pathology, when they understand normal structures.

Dentists and specialists worldwide are trained efficiently in diagnosis using traditional imaging modalities like intraoral and panoramic radiography. These imaging modalities have been taught for decades now in dental schools and in continuing dental education programs.

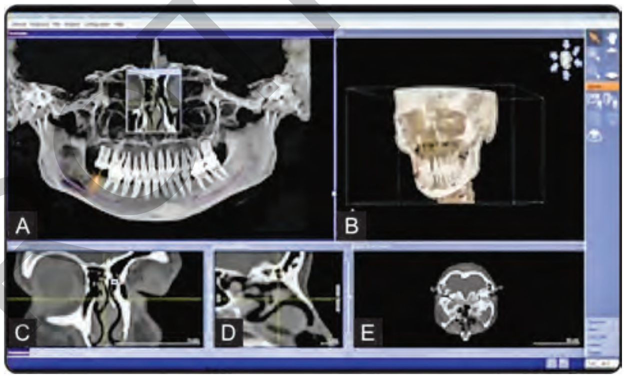
The main hurdle in understanding the images formed by cone beam computed tomography (CBCT) is lack of familiarity of oral maxillofacial specialists with the concept of three-dimensional (3D) imaging. Understanding the various images in different planes requires high level of competency, which is currently limited to fewer individuals.[1]

Diagnosis of maxillofacial pathology is only possible once you identify the normal anatomical structures. This Chapter looks into the various anatomical landmarks relevant to dental specialists as observed on various planes, i.e. sagittal, coronal and axial.

VISUALIZATION OF CBCT IMAGES

Imagine patient sitting in front of you on the dental chair. Just as his/her right side is the opposite side of the dentist, similarly, while viewing the CBCT images either on computer screen or film viewer, structures identified on the dentist's right side would represent the anatomical structures on the patient's left and vice versa.

Most of the CBCT manufacturers have labeled images with right and left sides or buccal/lingual/palatal/oral on the images, thus easing the procedure of identification (Figs 4.1A to E).



Figures 4.1A to E: Side identification present on various screen for easy orientation

MAXILLARY LANDMARKS

Nasopalatine Foramen/Incisive Foramen

The nasopalatine canal is usually described as being located in the midline of the palate, posterior to the central maxillary incisors.[2] The canal divides into two canaliculi on its way to the nasal cavity and terminates at the nasal floor with an opening (known as the foramina of Stenson) at either side of the septum. The canal contains the nasopalatine (incisive) nerve and the terminal branch of the descending nasopalatine artery, as well as fibrous connective tissue, fat and even small salivary glands.[2] On a periapical radiograph, it appears as a round to oval radiolucency between the roots and in the region of the middle and apical third of the central incisors (Fig. 4.2).[3]

The radiographic appearance varies depending upon the anatomical variations and also technique variation. On the CBCT, nasopalatine canal can be visualized as a canal starting from the floor of nasal cavity with dual foramina and exiting through the incisive foramen and spreading to anterior aspect of the hard palate (Figs 4.3 to 4.5).

Figure 4.2: Intraoral periapical radiograph of maxillary central incisor showing nasopalatine canal between central incisors

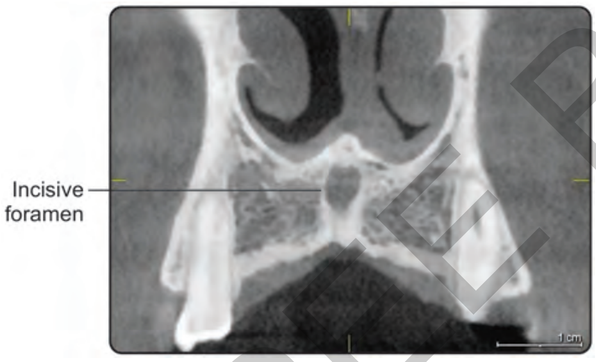


Figure 4.3: Coronal view showing incisive foramen

Figure 4.4: Cross-sectional view showing entire length of nasopalatine canal

Dental esthetics has become an important issue in implant dentistry. In the anterior maxilla, patients consider the esthetic outcome to be an essential factor, often surpassing even functional aspects of the dental implant therapy.[2] Implant contact with neural tissue may result in failure of osseointegration or lead to sensory dysfunction like paresthesia or numbness.[2] In view of these potential complications, the morphology and dimensions of the nasopalatine canal should be properly evaluated before placement of dental implants in the vicinity of this anatomical structures (Fig. 4.6).

On CBCT images, anatomical variations of nasopalatine canal can be seen. These canals are best visualized on coronal images. Type A, a single canal; Type B, two parallel canals; Type C, variations of the Y type of canal with one oral/palatal opening (one-fourth incisive foramen) and two or more nasal openings (one-fourth foramina of Stenson)[2] (Figs 4.7 to 4.9).

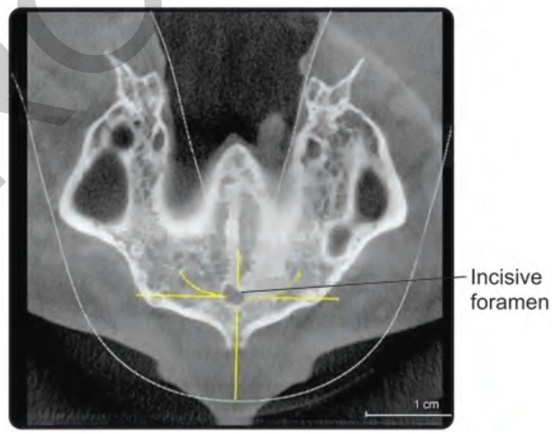


Figure 4.5: Axial view showing incisive foramen in anterior region of hard palate

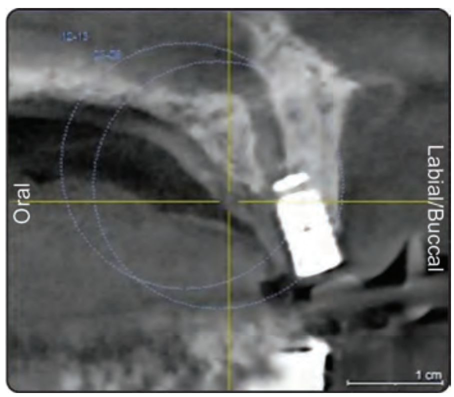


Figure 4.6: Cross-sectional view showing implant placed on nasopalatine canal

Figure 4.7: Type A nasopalatine canal

Figure 4.8: Type B nasopalatine canal

Figure 4.9: Type C nasopalatine canal

Gender variations in appearance of nasopalatine canal were present in the study done by Jacob et al.[2] In their study, male patients had a significantly increased length of the nasopalatine canal and higher values for the three different buccal bone plate measurements than females. Age significantly influenced the length of the nasopalatine canal with a decrease of the mean value in older patients.

Contradictory results were present with respect to width of crestal buccal bone wall with respect to duration of edentulism. In study conducted by Mardinger et al, the buccal bone plate anterior to the canal lost about 60% of its mean width when comparing fully dentate patients with edentulous ridges.[2] In contrast, Jacobs et al reported an increase in the canal diameter and foramina (nasopalatine foramina and incisive foramen) with the degree of ridge resorption accompanied by edentulism. The differences in the findings of the two studies could originate in the fact that only partially edentulous patients (not fully edentulous) were included in the present study and the average age of the included patients was 43.09 years (in contrast to 58.12 years in the study by Mardinger et al, 2008).[2]

Nasal Cavities

Nasal cavities (nasal fossa) are air-filled cavities, appearing as a radiolucent shadow on the periapical radiograph of maxillary central incisors. Intraoral periapical radiograph shows only the floor of nasal cavity. The CBCT shows entire dimension of nasal cavity as a radiolucent shadow. Coronal views are best to demonstrate the nasal cavity structures and paranasal sinuses.[1] The nasal septum is identified as radiopaque, partially ossified structures in the midline, dividing nasal cavity into two fossa. Deviated nasal septum is easily identifiable on CBCT coronal image. Inferior nasal concha is an independent facial bone, whereas middle and superior nasal conchae are parts of ethmoid bone. Middle nasal conchae are two of the osseous processes that separate nasal cavities into meatus or turbinates. The two well-defined and well-corticated soft tissue content structures in the anterolateral wall of the nasal cavity bilaterally are identified as nasolacrimal ducts. The nasolacrimal ducts drain tears from the orbits to the inferior nasal turbinates (Figs 4.10 to 4.13).

In cases of placement of maxillary anterior implant, the identification of this anatomical structure is important to prevent postoperative complications. The CBCT allows accurate measurement of the ridge height from the crest of the ridge to the floor of nasal cavity. Ideally, the implant length should be 2 mm away from the anatomical structure. Nasal cavity appears as a radiolucent shadow, seen on consecutive sections of cross-sectional images, thus assisting in identification of any pathologies of nasal cavity.[3]

Maxillary Sinus

Maxillary sinus is a critical anatomical structure in the maxillary posterior region of the jaw. The maxillary sinus, like the other paranasal sinuses, is an air-containing cavity lined with mucous membrane. It develops by the invagination

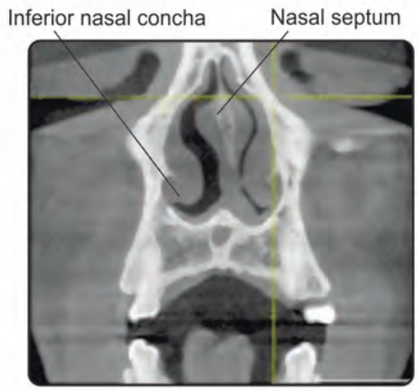


Figure 4.10: Coronal section at the level of canine region

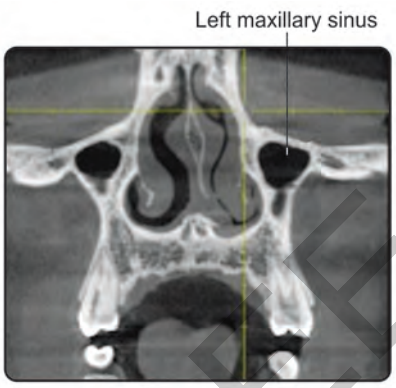


Figure 4.11: Coronal section of nasal cavity at premolar level

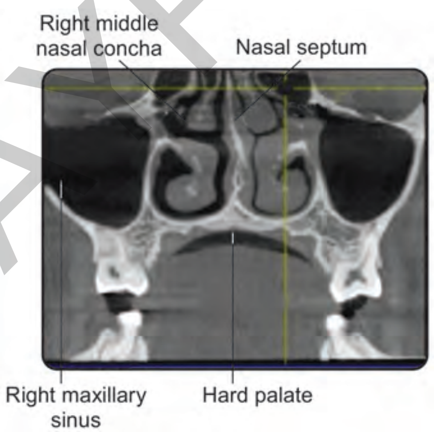


Figure 4.12: Coronal section of nasal cavity at molar region

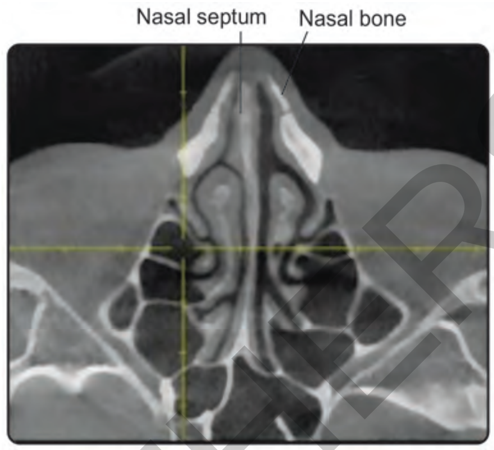


Figure 4.13: Axial view showing nasal cavity

of mucous membrane from the nasal cavity. Being the largest of the paranasal sinuses, it normally occupies virtually the entire body of the maxilla. The maxillary sinus is a pyramidal shaped cavity. Healthy sinus appears as a radiolucent (black) shadow because of the fact that air attenuates X-rays minimally. The maxillary sinuses are often asymmetric. Likewise, the anterior sinus borders are important in the anterior posterior implants, especially in cases of severe maxillary anterior ridge resorption.[3]

In conventional imaging techniques, entire sinus cannot be visualized in a single film, but on CBCT images maxillary sinus can be viewed in various sections simultaneously. Pathoses appeared as mucosal thickening and diagnosed preoperatively, treatment could be provided prior to implant placement. The CBCT provides information regarding the cortical bone in the floor of the nasal cavity and maxillary sinuses prior to implant placement. Coronal view at the level of anterior third of the orbit shows the draining sites of maxillary sinuses. These are narrow passages toward the superomedial wall of the maxillary sinuses leading into the middle nasal turbinate. Osteomeatal complex is formed partially from the ethmoid bone and a thin pointy osseous process on the antral wall of the nasal cavity known as uncinate process. Blockage of osteomeatal complex results in accumulation of inflammatory products into the sinus. Identification of these pathology is important prior to sinus grafting procedures (Figs 4.14 to 4.16).[1]

Lana JP et al in their study on anatomic variations in maxillary sinus by CBCT detected pneumatization (83.2%), antral septa (44.4%), hypoplasia (4.8%) and exostosis (2.6%). The identified lesions were mucosal thickening (≤ 3 mm in 54.8% and > 3 mm in 62.6%), polypoid lesions (21.4%), discontinuity of the sinus floor (17.4%), air-fluid level (4.4%), bone thickening of the maxillary sinus wall (3.8%), antroliths (3.2%), discontinuity of the sinus lateral wall (2.6%), sinus opacification (1.8%) and foreign body (1.6%).[4] This highlights the important role, the CBCT plays in understanding and diagnosing maxillary sinus pathologies.

A deep depression on the lateral wall of nasopharynx bilaterally as seen on axial images showing eustachian tube, which communicates between inner and external ear. Just posterior to the eustachian tube separated by soft tissue projection, lies the pharyngeal recess or fossa of Rosenmüller (Figs 4.17 to 4.19).[1]

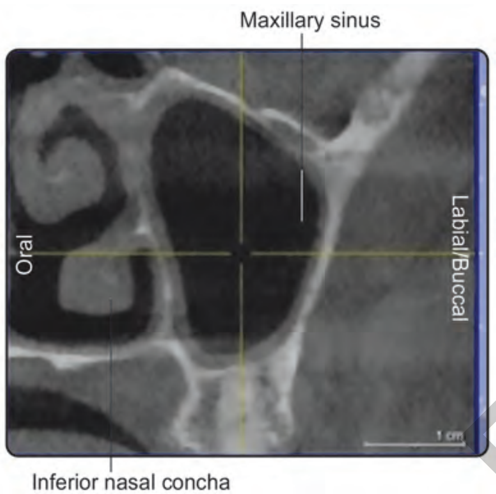


Figure 4.14: Coronal view of maxillary sinus showing floor, medial, lateral and roof

Figure 4.15: Sagittal view of the healthy maxillary sinus showing anterior and posterior wall

Figure 4.16: Coronal view of the both healthy maxillary sinuses appearing as radiolucent shadow

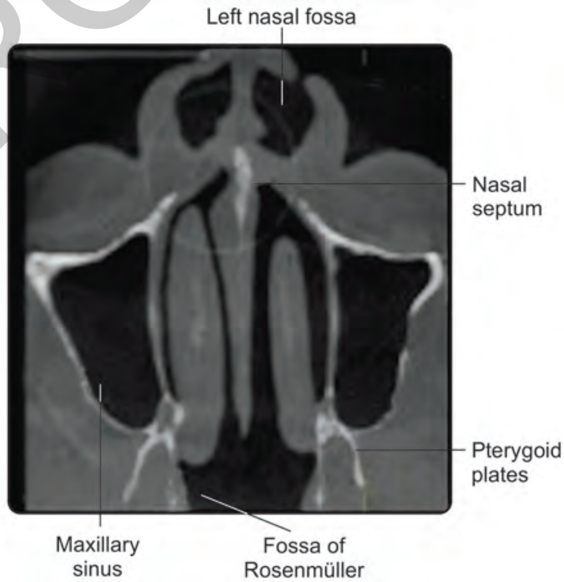
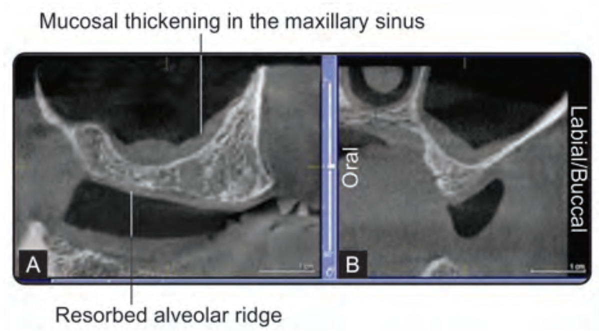


Figure 4.17: Axial view of both the maxillary sinuses

Greater and Lesser Palatine Foramen

The anatomy of the greater palatine canal is of interest to dentists, oral maxillofacial surgeons and otolaryngologists performing procedures in this area (e.g. administration of local anesthesia, dental implant placement, orthognathic Le Fort I osteotomies and sinonasal surgeries).[5] It houses



Figures 4.18A and B: Sagittal and cross-sectional window showing mucosal thickening in the floor of maxillary sinus

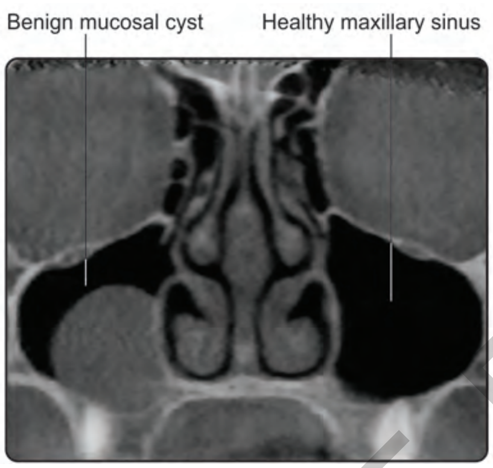


Figure 4.19: Benign mucosal cyst in right maxillary sinus; left maxillary sinus appears normal

the descending palatine artery (a branch of the third division of the maxillary artery), and greater and lesser palatine nerves (branches of the maxillary division of the trigeminal nerve) and their posterior, inferior, lateral nasal branches. These vessels run on the hard palate from posterior to anterior, just superior to the palatal roots of the maxillary molars in soft tissue in a palatal mucosa.[5]

The walls of the greater palatine canal are formed anteriorly by the infratemporal surface of the maxilla, posteriorly by the pterygoid process of the sphenoid, and medially by the perpendicular plate of the palatine.[6] The maxillary sinus is located anterior, and the nasal cavity and concha medial and the pterygoid plates posterior to the greater palatine canal. The anatomy of these structures undoubtedly affects the anatomy of the greater palatine canal due to their proximal relationships. When performing surgical procedures in this area, preservation of the descending palatine artery and palatine nerves is essential to avoid excessive bleeding and to maintain nerve supply to the maxilla.[5] In other cases, regional nerve block may be unsuccessful if excessive resistance is met when injecting local anesthesia into the greater palatine canal, presumably the result of anatomic variation. The CBCT clearly demonstrates the greater and lesser palatine foramina on axial views (Figs 4.20 to 4.25). The average length of the canal is found to be 29 mm with a range of 22–40 mm.[5]

Ethmoid and Sphenoid Sinuses

The ethmoid sinuses are made up of numerous, small, thin-walled air cells separated by the vomer bone in the midline. Their complicated anatomy gave them the characterization of the ethmoid labyrinth. The sphenoid sinus is located just posterior to the ethmoid sinuses. These are air cavities that are irregular in shape and size, located just

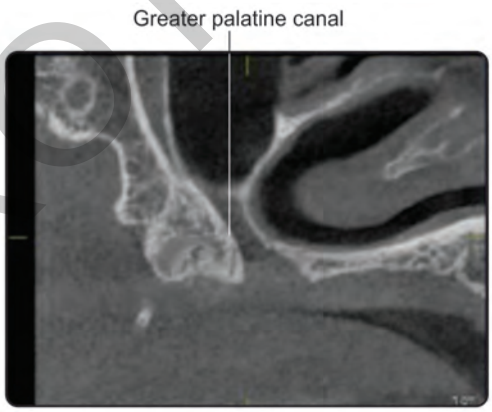


Figure 4.20: Tangential view of greater palatine canal extending anteroinferiorly

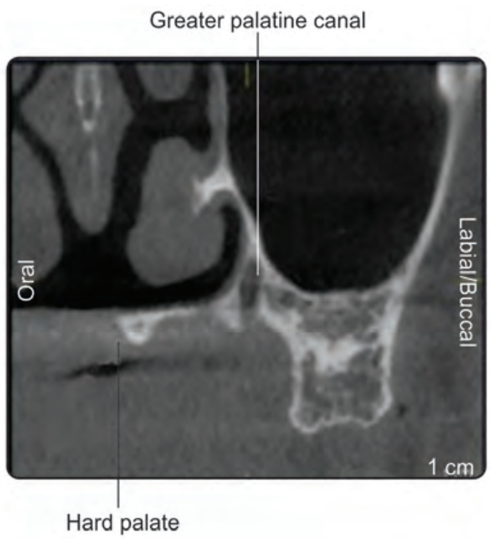


Figure 4.21: Coronal view showing greater palatine canal

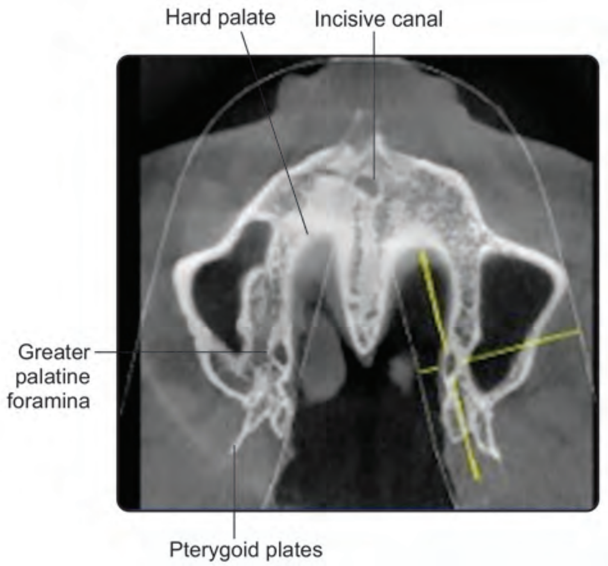


Figure 4.22: Axial view showing greater and lesser palatine foramina

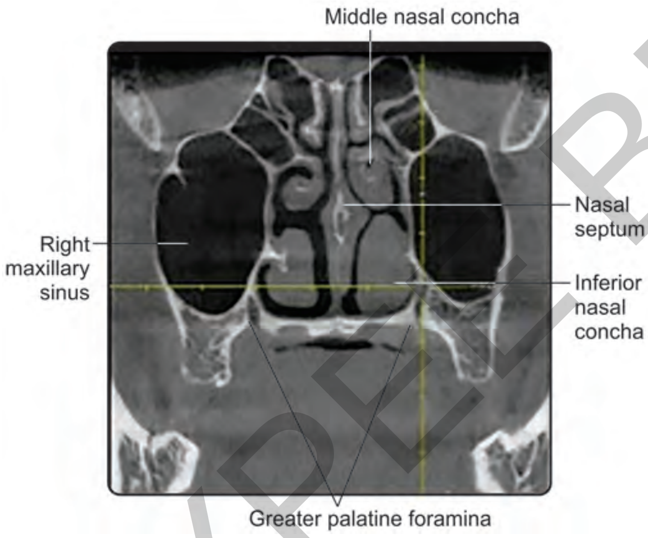


Figure 4.23: Coronal view showing right and left greater palatine canals

below the base of sphenoid bone. Anatomic variation and septations are often present. Healthy sinuses appears as a radiolucent shadow (Fig. 4.26).[1]

Frontal Sinus

Frontal sinus is one of the paranasal sinuses, which is present on the frontal part of the skull. Coronal view at the level of anterior part of the orbit reveals entire anatomy of the frontal sinus. Anterior and posterior recess have been

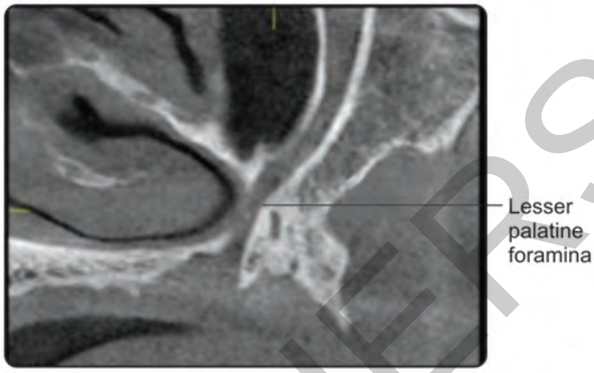


Figure 4.24: Tangential view of lesser palatine canal

Figure 4.25: Axial view showing greater and lesser palatine foramina

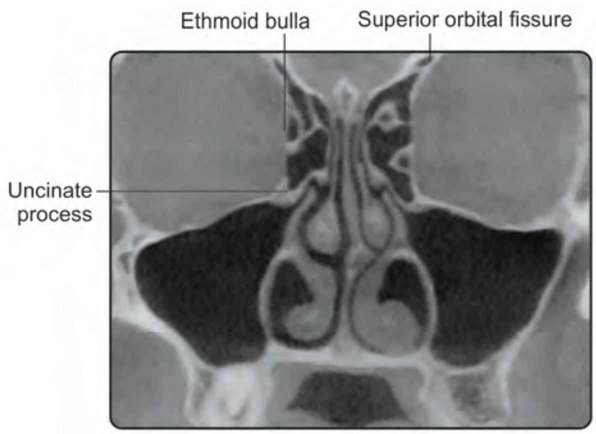


Figure 4.26: Coronal view showing ethmoid sinuses

clearly identified on CBCT images. As mentioned earlier, healthy frontal sinus appears as a radiolucent image; whereas in conditions such as sinusitis, mucosal thickening or grayish shadow is evident (Fig. 4.27).

Hard Palate and Soft Palate

The hard palate is a thin horizontal bony plate of the skull, located in the roof of the mouth. It spans the arch formed by the upper teeth. It is formed by the palatine process of the maxilla and horizontal plate of palatine bone. It forms a partition between the nasal passages and the mouth. Hard palate appears as a thick radiopaque shadow above the apices of maxillary teeth separating oral cavity and nasal cavity. Posteriorly, hard palate continues as soft palate. Soft palate forms the posterior part of the root of the oral cavity. Soft palate is seen as a grayish horizontal shadow extending from distal aspect of hard palate and sloping backwards and downwards. It is distinguished from hard palate, as it does not contain bone (Fig. 4.28).

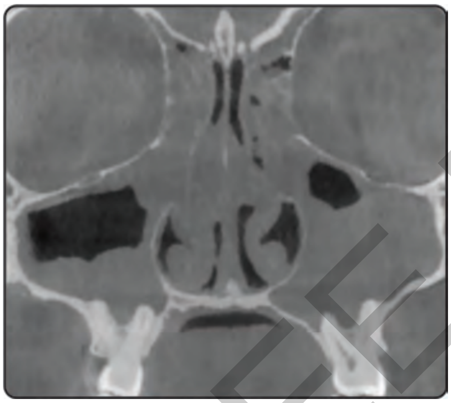


Figure 4.27: Coronal view showing pansinusitis

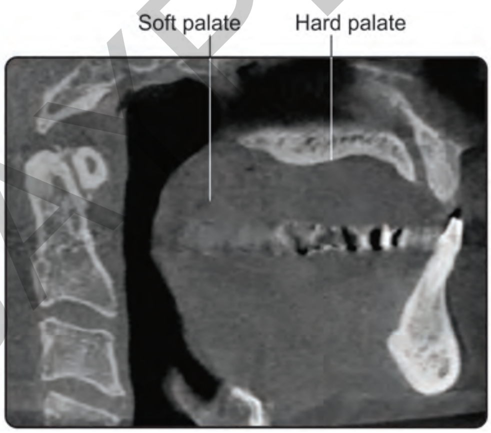


Figure 4.28: Sagittal view showing hard and soft palate

Zygomatic Arch

The zygomatic arch or cheek bone is formed by the zygomatic process of temporal bone (a bone extending forward from the side of the skull, over the opening of the ear) and the temporal process of the zygomatic bone (the side of the cheekbone), the two being united by an oblique suture (zygomaticotemporal suture) (Figs 4.29 to 4.31).

Zygomatic arch is commonly involved in zygomatic complex fracture. Two-dimensional imaging like posteroanterior (PA) Water's view shows the level of fracture line, but amount of displacement of fracture fragment is not depicted clearly. The CBCT shows zygomatic arch as a thick radiopaque shadow on lateral aspect of maxilla. Axial view is best view to demonstrate the extent and location of fracture (Fig. 4.32).

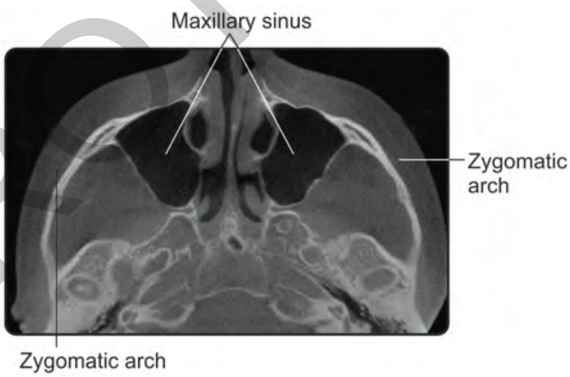


Figure 4.29: Axial view showing bilateral normal zygomatic arches

Figure 4.30: Three-dimensional reconstruction showing normal left zygomatic arch

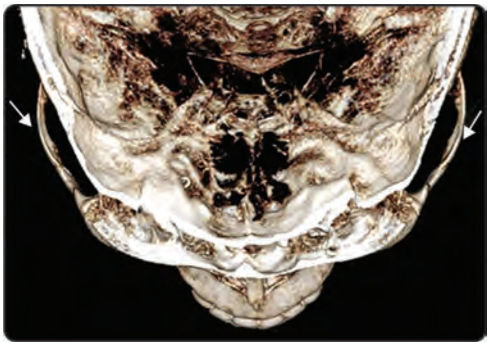


Figure 4.31: Axial three-dimensional reconstructed view showing bilateral zygomatic arch

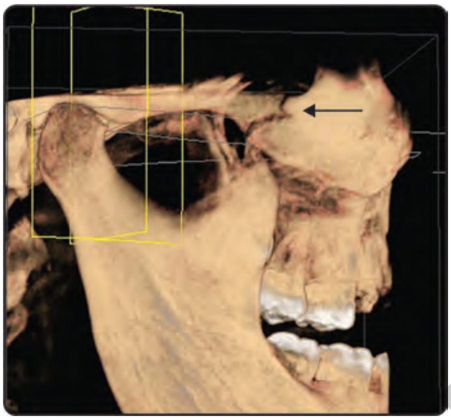


Figure 4.32: Right zygomatic arch fracture seen on three-dimensional reconstruction

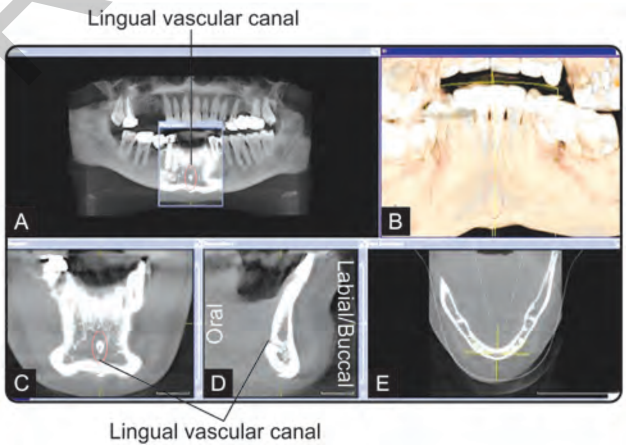
MANDIBULAR LANDMARKS

Lingual Vascular Foramen

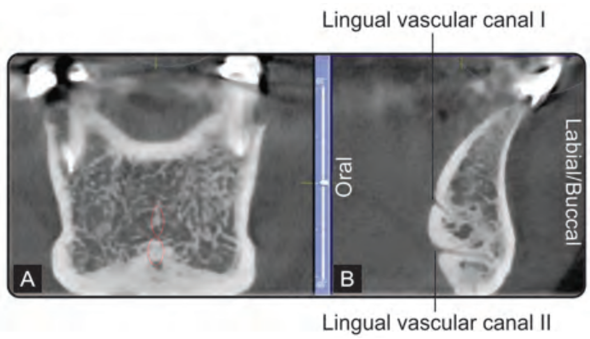
Mandibular interforaminal region (premolar-premolar) was considered to be the safest zone for implant placement. But recent literature suggests that it is no longer considered to be the risk-free zone for implants. A significant anatomic structure in the lingual aspect of the mandibular bone, along the midline of the mandible is the lingual foramen or foramina, which harbors terminal branches of lingual artery. These are closely associated with genial tubercles, which serve as muscle attachment. Ennis, Suzuki and Sakai, McDonnell et al Darriba and Mendonca– Caridad and Givol et al assumed a vascular content being an anastomosis of the sublingual branch of right and left lingual arteries.[3]

The diameter of these canals are related to the blood-supplying capacity of the blood vessel, and as a result, if they are wide enough, they may bleed significantly if injured during implant surgery resulting in sublingual hematoma formation, asphyxia and death. Depending upon the amount of residual ridge resorption, these canals may be seen close to the crest of the ridge. Goaz and White stated that the foramen and canal were the termination of the incisive branch of the mandibular canal. According to Yoshida et al found low frequency of occurrence (45.7%) of lingual foramen on internal surface of mandible on dry cadavers. According to McDonnell et al, lingual foramen was present in 99.04% in midline of mandible. These canals run from lingual cortical plate extending inferiorly toward the cancellous part of bone. Cross-sectional images on CBCT are ideal for locating these canals. Occasionally, double lingual vascular canals can also be seen. Yoshida et al believed that lingual artery visualization on radiography was difficult and CT provides an adequate visualization of the vascular canal.[3] Multiplanar reformation (MPR) provide excellent visualization of midline mandibular structure clearly depicting the lingual canal and size of the lingual canals correlate well with the results of anatomic studies.[1]

The small difference in the size values of the canals can probably be attributed to the fact that the smallest canals were too small to be visible because of the limited resolution capability of CT. Gultekin et al in their study revealed typical lingual canal locations were the middle of the mandible and the premolar regions (Figs 4.33A to E and 4.34A and B).



Figures 4.33A to E: Lingual vascular canal in various slices present at midline of mandible



Figures 4.34A and B: Double lingual vascular foramina

Mental Foramen

Mandibular nerve exists through the mental foramen. It transmits mental nerve, artery and vein. Mental nerve is a branch of inferior alveolar nerve, which supplies sensation to lower lip and the labial mucosa and lower canines and premolars.[7]

Intraoral periapical (IOPA) radiographs shows either a slit shaped or a complete dimension of the mental foramen depending upon the angulation of the X-ray beam to the mental foramen.

Cone beam CT is the radiographic method of choice to depict mental foramen. Variations in the position of the mental foramen are also common. Typically, the foramen is located halfway between the alveolar crest and the lower mandibular border between the first and second premolars (Fig. 4.35).

However, it may be found as far anterior as the canine and as far posterior as the first and second molars. The neurovascular bundle may loop downward, forward and medially before exiting from the foramen in a posterosuperior direction. In older edentulous individuals with resorbed ridges, the foramen may be near or may actually emerge from the alveolar crest likewise (Figs 4.36 and 4.37).

Accessory mental foramina is also a common finding with an overall incidence of 6%–10%. The accessory mental foramen (AMF) was defined as a buccal foramen with continuity to the mandibular canal. Also, a buccal foramen showing continuity without mandibular canal was considered to be nutrient foramen. The incidence of accessory mental foramen varies between ethnic groups and is reported as follows:[7]

- 2.6% in French
- 1.4% in American Whites
- 5.7% in American Blacks
- 3.3% in Greeks
- 1.5% in Russians
- 3.0% in Hungarians.

Gershenson et al in a study of 525 dry mandibles and 50 cadavers, reported incidences of 23 mandibles with double foramina (4.3%), four with triple foramina (0.7%) and one skull with four foramina on one side.[8] The absence and variation of accessory mental foramina has been reported in dry human mandibles and radiographs previously, and can range from 0.2% to 10.6% on one side.[8] The presence of more than one MF, referred to as accessory mental foramina (AMF), has been noted on dissection, surgical findings, conventional radiographs, spiral CT and CBCT.[8]

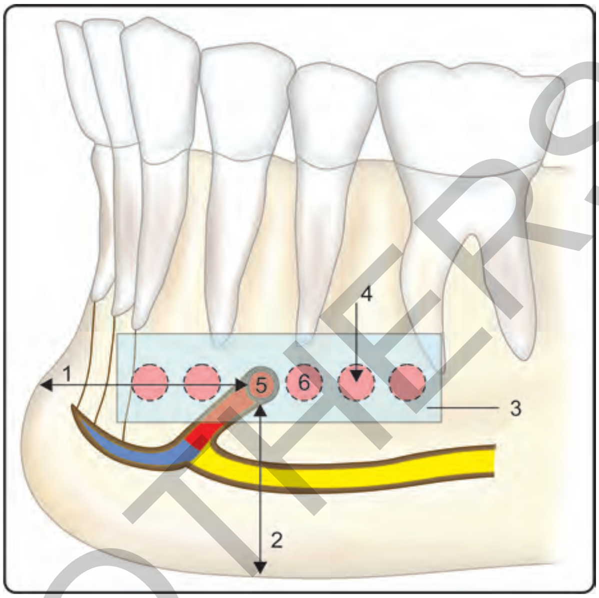


Figure 4.35: Anatomical variations of the mental foramen (MF) position in the horizontal plane in relation to the roots of teeth; blue, mandibular incisive canal (MIC); red, mental canal (the anterior opening of the mandibular canal); yellow, mandibular canal. **1.** Distance from MF to midline of the mandible (approximate distance 28 mm); **2.** Distance from MF to the inferior border of the mandible (14–15 mm); **3.** Possible MF location zone in the horizontal plane in relation to the roots of teeth; **4.** The shape of MF can be round or oval, the diameter is 1.68–3.5 mm; **5.** Prevalence location of MF in the horizontal plane for Caucasian population; **6.** Prevalence location of MF in the horizontal plane for Mongoloids and African people. *Courtesy:* www.ejomr.org/JOMR/archives/2010/1/e3/e3ht.htm.

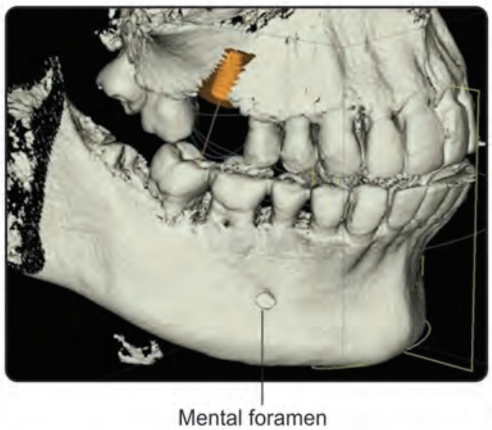


Figure 4.36: Mental foramen on three-dimensional reconstruction

Figure 4.37: Coronal view showing bilateral mental foramen

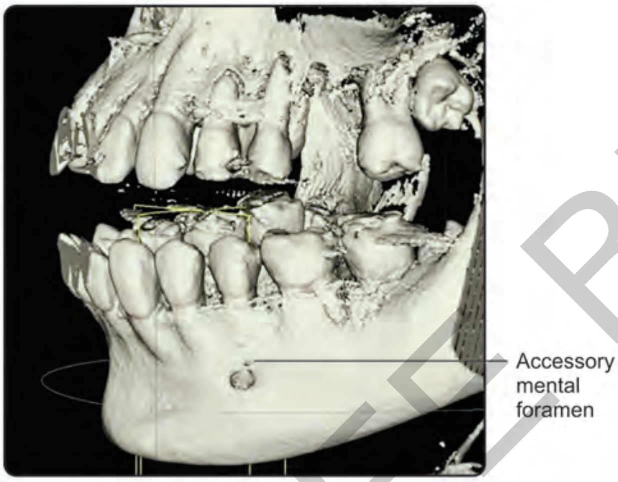


Figure 4.38: Three-dimensional construction showing accessory mental foramina superior to mental foramen

The AMF can be rarely observed with intraoral and panoramic radiography because the size is generally less than 1.0 mm.[8] The CT is the most accurate imaging modality for the identification and localization of the mandibular foramen, mandibular canal and MF. The localization of such structures, as well as their eventual anatomical variations, is of fundamental importance prior to any surgical and anesthetic procedure.[8] Result in study showed that incidence of accessory mental foramen in Indian population was 8.4%. Highest incidences of AMFs are reported in Negros and Maori mandibles. Position of the accessory mental foramina may be superior, inferior, anterior or posteriorly to mental foramen (Figs 4.38 to 4.41).

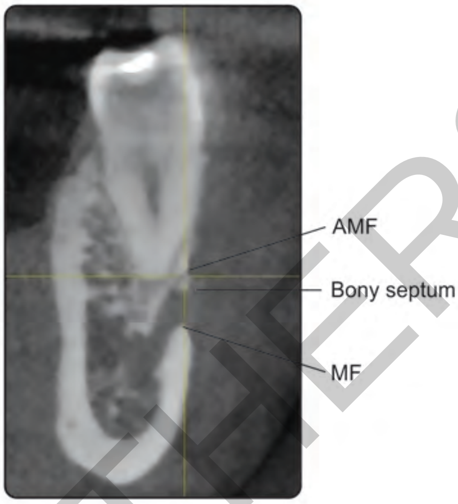


Figure 4.39: Cross-sectional and three-dimensional reconstruction of accessory mental foramina (AMF); mental foramen (MF)

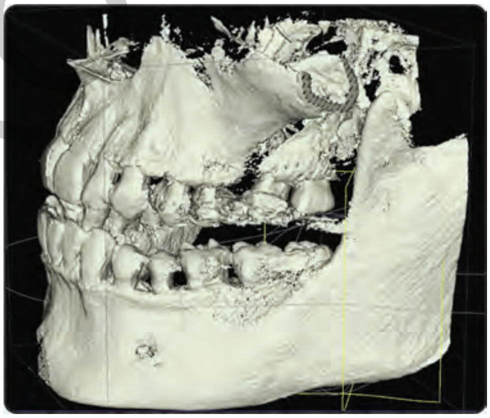


Figure 4.40: Accessory mental foramina inferior to mental foramen

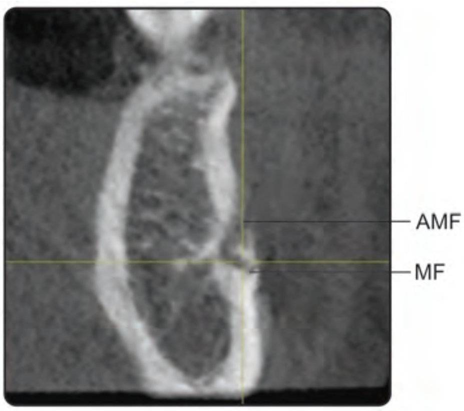


Figure 4.41: Cross-sectional image showing accessory mental foramina (AMF) below mental foramen (MF)

Anterior Loop of Mental Nerve

The final part of the inferior alveolar nerve sometimes passes below the lower border and the anterior wall of the mental foramen. After giving off the smaller mandibular incisive branch, the main branch curves back to enter the foramen and emerge to the soft tissues as the mental nerve. The section of the nerve in front of the mental foramen and just before its ramification to the incisive nerve can be defined as the anterior loop of the inferior alveolar nerve. Elective surgery in the area of the anterior mandible such as implant installation in the interforaminal region or symphysis bone harvesting, may violate the anterior loop resulting in neurosensory disturbances in the area of the lower lip and chin.[7]

This structure has a high prevalence (61.5%–96%) in cadaveric studies, with symmetric occurrence a common finding (76.2%), anterior loops were most often observed bilaterally, followed by on the right side only. The visibility of anterior loop reduces as the age of the subjects increased.[7] On consecutive cross-sectional images, round radiolucent shadow is appreciated anterior to mental foramina. These shadows represent anterior loop of mental nerve (refer Fig. 4.35).[3]

Mandibular Canal

Mandibular canal is the most critical anatomical structure in mandibular posterior region. Identification of this landmark is of prime importance prior to implant surgery, third molar disimpaction or periapical surgery. Conventional imaging cannot show the complete extend of the MC. Buccopalatal orientation of the MC is not appreciated even on panoramic radiograph. Canal may not be visible on conventional radiographic methods; it is probably related to the fact that the inferior alveolar neurovascular bundle is not always surrounded by an ossified canal. The bony sheath seems to disappear anteriorly toward the MF. Similarly, in edentulous patients, the diameter of the artery is smaller compared to dentate patients, and hence the visibility of the canal may be affected. The mandibular nerve may course diagonally from a lingual location posterior to a buccal location in the area of the MF. The buccal-lingual position of the nerve can only be seen on CBCT—either axial or cross-sectional views of the mandibular ridges.[3] Cross-sectional slices provide consecutive sections, which depicts the course of the inferior alveolar nerve up to MF (Figs 4.42A and B).

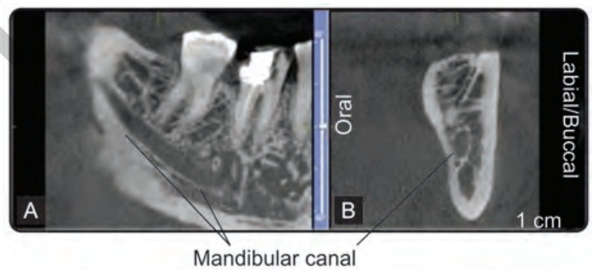
Currently, all CBCT software have color coding by which MC can be color coded and traced entirely from lingual foramen till the MF (Fig. 4.43). This eases identification of the mandibular canal, which may be sometimes difficult on conventional imaging especially in osteoporotic individuals. Variation in anatomy of MC such as bifid mandibular canal, is also identified easily on CBCT (Figs 4.44A and B).

Cervical Spine

Sagittal images of the neck are best for assessment of the cervical spine and the airway. The cervical spine is only partially visualized in a CBCT scan (Figs 4.45 and 4.46). The normal appearance of the vertebral bodies include a fairly square body with thin cortical outline, a cancellous component of homogenous density and a fairly symmetric spacing between vertebrae visible in the scan.[1]

Airway Space

The airway is identified as an irregular shaped, elongated low-density area to cervical part of the vertebral column. The position of the epiglottis, laryngeal opening below the epiglottis and the position of the tongue may have an effect on the diameter of the airway. The CBCT is the ideal imaging techniques to evaluate patients with sleep apnea by



Figures 4.42A and B: Mandibular canal. **A.** Mandibular canal seen on tangential image as linear canal below apices of teeth; **B.** Cross-sectional image shows a round radiolucent shadow close to lingual cortical plate.

Figure 4.43: Color coding of mandibular canal

Cone Beam Computed Tomography

A Clinician's Guide to 3D Imaging

Salient Features

- Cone beam computed tomography (CBCT) has brought a paradigm shift from 2D imaging to 3D imaging in the dental field
- Applications of CBCT range from dental implantology, oral maxillofacial surgery, orthodontics, sleep apnea, temporomandibular joints, orthognathic surgery, etc.
- The 2D imaging suffers from inherent limitations of magnification, distortion and superimposition, which is easily surpassed by CBCT
- Dental fraternity needs to understand the way of relating the CBCT images to patient's anatomy
- Highlights the basic principle of CBCT, normal appearance of maxillofacial landmarks on CBCT images and applications of CBCT in dental field.

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