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*RESEARCH ARTICLE*

# ROLE OF CBCT IN IMPLANT PLACEMENT IN MANDIBULAR PREMOLAR REGION

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## *Abstract*

Implant placement has now become the lifeline of dentistry, but the most of the aspect of its treatment begins with the diagnosis of patient's condition.Rehabilitating patients with dental implants require thorough evaluation of the implant site.All the vital structures need to be evaluated and a safe distance should be maintained while planning for implant like the nasal floor, maxillary sinus in maxillary region and mental foramen, inferior alveolar nerve and sublingual concavities in the mandible. The mandibular anterior inter-foraminal region was previously considered to be a safe region for surgical procedures of the mandible but now it has been realized that presence of anterior loop of inferior alveolar nerve make it an area that should be thoroughly evaluated. The selection of a suitable imaging modality along with the judgment of the expert clinician about the clinical situation aids in the treatment planning. Previously clinicians were relying on 2-dimensional imaging techniques, which have now been replaced by CBCT, the most widely used tool for treatment planning of implant placement.



## Introduction:-

Pre-operative surgical planning is essential for successful dental implant treatment.Rehabilitating patients with dental implants require presurgical information and post-surgical assessment. To ensure the effectiveness of surgical procedures and toprevent iatrogenic complications the clinician should be thorough with the normal anatomy and its variations as the jaws contain many critical areas which need to be evaluated and a safe distanceneeds to be maintained while planning for placement of an implant.

In the maxilla: the dentist needs to keep a safe distance of 2mm between the implant and the limiting structures, the nasal floor in the anterior and the maxillary sinus in the posterior maxilla. In mandibular posterior region: mandibular canal, surgical boundaryis often set conservatively 2 mm above the mandibular canal and the sublingual concavity need to be taken into consideration at time of treatment planning to avoid any future complications. Life-threatening haemorrhage from significant internal bleeding in the floor of the mouth usually caused by a perforation of the lingual cortical plate may occur although rare but may occur.In mandibular anterior region, mental foramen and the anterior loop of inferior alveolar nerve are present, the most distal portion of the implant is ideally placed 2 mm anterior to this border whichever is mesial. The antero-posterior position of the mental foramen is variable and

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may correlate as far forward as the apex of the first premolar to as far distal as below the mesial root of the first molar. The mandibular anterior inter-foraminal region was previously considered to be a safe region for surgical procedures of the mandible but now it has been realized that presence of vital anatomical structures such as incisive canal and the anterior loop make it an area that should be thoroughly evaluated.
Sicher's oral anatomy defines the anterior loop as "the mental canal which originates from the mandibular canal and goes inside out and leads to upward and backward to end up at the mental foramen"[2]

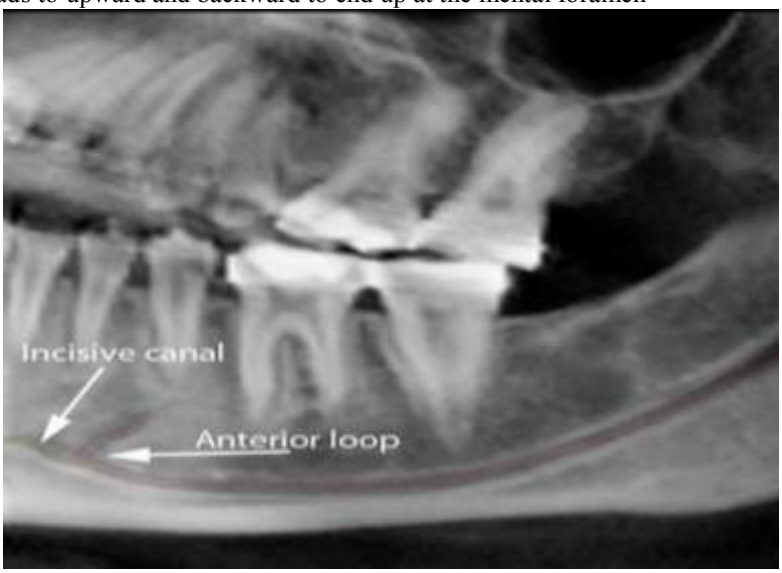


**Figure 1:-** Anterior loop of inferior alveolar nerve.

The selection of a suitable imaging modality along with the judgment of the expert clinician about the clinical situation aids in the treatment planning. Various radiographic techniques give an understanding of the anatomical structures especially in the mandibular arch which are crucial in any surgical procedures with regards to osteotomy, nerve repositioning andridge splitting for implant placement. It is important for a clinician to study bone density, thickness and integrity of the cortical bone and also the optimal position and orientation of the implant in addition to the vital anatomic structures. 3-dimensional digital radiography has been used predictably with high success rates in the clinical practice. The advent of cone beam computed tomography (CBCT) imaging has expanded the doors for analysing morphologic parts of the head and neck structures, including the alveolar bones and nerve canals. CBCT caters for the oral and maxillofacial region in different anatomical planes, thus its application can precisely estimate the stature and thickness of the alveolar bone where an implant is intended to be placed.[1] Selecting the osteotomy site for the placement of implant can sometimes be challenging to the clinician because of the close proximity to the inferior alveolar nerve (IAN), mental foramen (MF) and maxillary sinuses. Placement of the implant in the partially dentulous as well as edentulous mandibular arch can sometime be a nightmare for the clinician because of the variation in the course of the IAN and its exit from the MF.

**Radiography For Implant Placement In Premolar Region**

Treatment planning remains the ultimate step that has to be given paramount importance prior to implant placement and is undoubtedly one of the keys to success. The boneconsideration and the limiting structures in the jaws or in close relationship to them remain one of the most important criteria for implant planning. The bone is the prime importance since any implant placement planning is based on the available bone. The available bone quality and quantity are considered in the form of available bone height, bone width, bone length (mesio-distal) dimension, available bone angulation, bone density, and crown height space. DR CARL E. MISCH has mentioned available bone height in an edentulous site is the most important dimension for implant consideration, because it affects both implant length and crown height. This is followed by bone width, length, angulation.[2] These factors help to decide whether the available bone is abundant enough that no manipulation would be required or we would need osteoplasty or bone grafting techniques. Rehabilitating patients with dental implants require presurgical information and post-surgical assessment. To prevent iatrogenic complications and to ensure the effectiveness of surgical procedures the clinician should be thorough with the normal anatomy and its variations. While placing implants in mandibular premolar region, anatomical structured to be considered are mainly mental foramen, inferior alveolar

nerve in mandibular canal, anterior loop of inferior alveolar nerve, lingual concavities (sublingual fossa and submandibular fossa).

Consequently, the use of appropriate imaging techniques is important in identifying the exact location of the anterior loop when a dental implant is installed into the premolar and molar regions.An astute clinician will fail if he or she does not take the help of the "THIRD EYE" that is the radiology for planning implant placement14. Conventional 2D radiographic techniques are being commonly used by the dental practitioners to quantify and assess theavailable bone for purpose of implant planning. The inherent distortion in the machine and the variations in positional technique errorfurther magnify the distortion, the representation of a three-dimensional structure in two-dimensional form ultimately leading to inaccuracy and unwanted stress.

**Different radiographic techniques for identification of anterior loop are:**
**Periapical radiographs**:
Bavitz et al.,37 who reported 54% of loops in periapical radiographs, but only 11% were verified by dissection

**Panoramic radiography** :
Kuzmanovic et al. showed 50% of the radiographically observed anterior loops of the mental canal were misinterpreted by observers with panoramic radiography and 62% of the anatomically identified loops were not observed radiographically .Misch identified -12%, Misch and Crawford - 12%: Arzouman et al. --56%. Kuzmanovic et al.47 detected the anterior loop on27% (six of 22) of panoramic films and 35% (eight of 22) of the dissected specimens.[4] The panoramic radiography has been used for a long time as the only diagnostic exam in implant dentistry; however, in some cases it is not possible to identify the mental foramen or the extension of the anterior loop accurately. These often offer poor resolution and size distortions can be severe depending on the region. Vertical measurements in PR are less reproducible than Horizontal.Two-dimensional visualization of a three-dimensional structure can lead to error and complications.

**CT Scans**:
Jacobs et al. (2002) reported an incidence of 7% on the anterior loop on their CT sample whilst Kaya et al. (2008) 34%. In the most recent CT study Watanabe et al. (2010) reported a prevalence of 55%, a percentage that lies very near to findings of Apostolakis D, Brown JE. CT scan led to high radiation dose. In CT studies, the range is 7% to 83% .[4]

**Recently, cone beam computed tomography (cbct):**
A new imaging modality, cone beam computed tomography (CBCT) has a higher spatial resolution with a significantly lower radiation dose than conventional CT. It has been shown that magnification of CBCT in linear measurements does not occur and that the images are more accurate than those obtained with medical CT17. Studied on CBCT identification of anterior loop is Kajan and Salari's:36.9% , Apostolakis and Brown- 48%. Aleksandar Vujanovic-Eskenazi et al-48.8%.[4]Variations in the location and length of the anterior loop of the inferior alveolar nerve have been reported in various studies.

Several authors have recommended various standard safety margins, ranging from 1 to 9 mm for the most anterior portion of mental foramen as reference guide.[1]Hence it is important forevery clinician to determine and evaluate the presence of anterior loop in the mental foramen region at time of implant planning using a CBCT.

**Complications Of Implant Placement In Mandibular Premolar Region**
**-Nerve Damage**
Placement of an implant in mandibular premolar region could seem a little problematic due to the presence of the inferior alveolar nerve in the mandibular canal traversing just below the apices of mandibular posterior teeth, sometimes forming a loop in front of the mental foramen known as the anterior loop of inferior alveolar nerve, and then exits through the mental foramen dividing into two branches i.e., mental nerve and incisive nerve. The usual location of mental foramen is below the apex of the 2nd premolar. Failure to identify these structures during surgical procedures has led to postsurgical complications arising from injury to the inferior alveolar nerve during surgical procedures, Dysesthesia (altered sensation) of the lower lip due to mental nerve injury is one of the most serious complications of mandibular implant surgery. Dysesthesia can be of various types, Paraesthesia (numb sensation), hypoesthesia (reduced sensation), hyperaesthesia (increased sensation), anaesthesia (loss of sensation). As a result, a number of studies have reported an incidence of transient altered sensation from 8.5% to 24% during periods of up

to 3–16 months postoperatively following implant surgery. Several authors have recommended various standard safety margins, ranging from 1 to 9 mm for the most anterior portion of mental foramen as reference guide.[1]

**-Perforation**

Placement of an implant in the mandibular premolar or molar region should be done considering the possibility of the lingual concavities caused by the submandibular and the sublingual fossa. Perforation of the lingual or buccal bone plate of mandible can occur due to incorrect angulation or positioning of dental implant. Life-threatening haemorrhage from significant internal bleeding in the floor of the mouth, usually caused by a perforation of the lingual cortical plate may occur although rare but may occur.

**Role Of Cbct To Prevent Complications**

**CBCT to prevent nerve damage**:

During treatment planning of implant the region of interest should be inspected on CBCT software in all the three planes. presence of mental foramen should be checked on both axial and coronal slice of the region of interest. coronal section will show a single well-defined radiolucency in the premolar region indicative of mental foremen. if two distinct radiolucencies are seen, it is indicative of the presence of anterior loop of inferior alveolar nerve. In mandibular posterior region usually the mandibular canal containing the inferior alveolar nerve can be clearly visualised. Safe distance from the nerve to the implant should be a minimum of 2mm. accordingly the length and position of the dental implant will be selected.

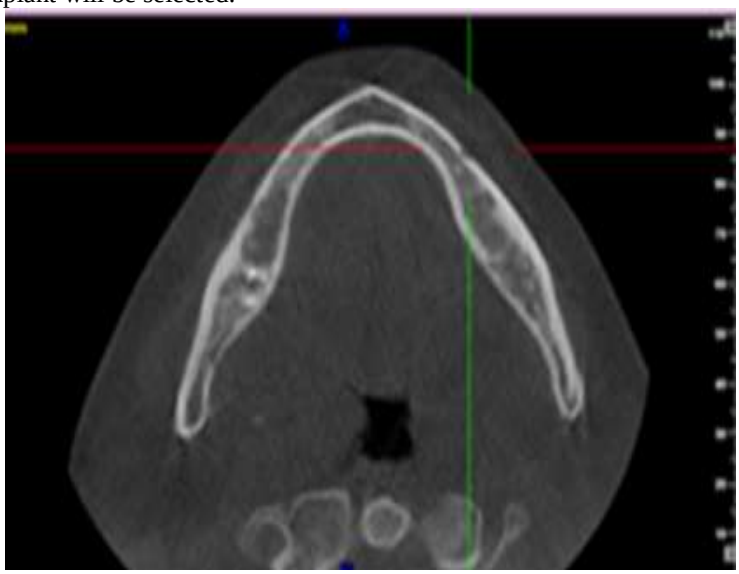

**Figure 2:-** Axial slice showing position of mental foramen.

**Figure 4:-** Mental foramen and sublingual concavity.

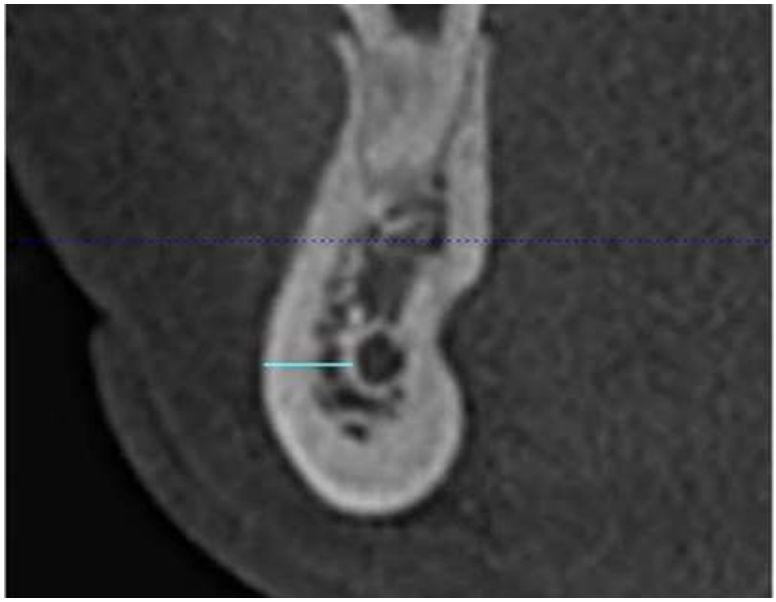

**Figure3:-** Two radiolucencies indicative of presence of anterior loop of inferior alveolar nerve.

**CBCT to prevent perforation**:
pre-treatment analysis of the cbct radiograph of the patient should include the determination of presence of lingual concavities of either submandibular fossa, sublingual fossa or others. if present their extent and depth should be checked on appropriateaxial and coronal slices. presence of deep concavities might sometime require a change in angulation of dental implant to prevent perforation of the lingual bone plate. Length, position and angulation of the dental implant will be selected accordingly.

**CBCT for placement of virtual implant**:
some CBCT software allows us to place virtual implant on the site of interest. Implants with different angulations, length and positions can be placed and evaluated for any complications. the desired position when selected can then be tried to simulate in the patient.

## Conclusion:-

Most of the complications occurring after implant placement in mandibular premolar region are due to damage of the inferior alveolar nerve. To avoid severe complications that can be caused due to negligence of important anatomic and biologic considerations, make the pre-treatment analysis of the implant site really necessary.The literature regarding the prevalence and the length of the anterior loop gives varied results and hence it is difficult to determine safe distance while implant placement from the mental foramen and prevent iatrogenic damage. CBCT is an important aid helping the clinician to analyse and be prepared with the difficulties that may arise during the surgical procedures. Presence and length of anterior loop guides the clinician to finalise the treatment plan.

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