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## Anatomical Determinants For Implant Placement

1.Dr. Nazish Baig , 2.Dr. Isha Gotmare , 3.Dr. Sakshi Suryawanshi , 4.Dr. Pranav Bhale ,  
5. Dr. Akash Todsam

1.Professor and PG Guide , 2. Postgraduate student , 3. Postgraduate student , 4. Postgraduate student ,  
5. Postgraduate student.

**Abstract** - This article throws light on the important anatomical and surgical sites for implant placement in both maxilla and mandible.

It can be an anatomical guide for beginners in implant dentistry and also it is crucial for the preoperative planning of various implant procedures . This includes the exact assessment of various anatomical factors, such as the position of the mandibular canal, the maxillary sinus, the width of the cortical plates and planning being the most appropriate.

**Keywords**- Implants, mandibular canal , osseointegration , alveolar ridge width, Incisive foramen , maxillary sinus , tilted implants.

**Introduction** – There are various options of rehabilitating teeth through fixed and removable prostheses and in this new epoch, with the materialization of implants in dentistry, for over 4 decades implants have been serving as the third set of dentition for people. Today, dental implants are placed with a huge success rate in private dental clinics as well as dental institutions. Although , serious complications might occur like neurosensory disturbances , haemorrhages etc during or after the placement of implant and thus It is essential of have a thorough knowledge of the anatomy and its variations prior to implant placement. The rehabilitation treatment by means of osseo-integrated implants aims to preserve the integrity of the noble intraoral structures, recovering the aesthetics and functionality of the stomatognathic and phonetic system, allowing a better quality of life for patients <sup>[1]</sup>.

**Bone considerations for implant placement:** The available height and width of the residual bone is a determining factor for implant placement in both maxilla and the mandible. Insufficient residual alveolar bone may result in subsequent failure of the implant. Guidelines for placement of implants recommend that the aim should be to maximize bone-to-implant contact(BIC) at the site to be restored within the anatomical and physiological limitations <sup>(2)</sup>. Greater the amount of bone in an implant site, more is the ratio of bone to implant surface area, which enhances the chances of successful osseo- integration. Post-integration resistance to forces generated by the restoration in function is also increased if a denser bone is surrounding the implant <sup>(2)</sup>.

It is of utmost importance for circumferential osseointegration that the alveolar ridge width should be enough to allow 1.5mm of bone on both the labial as well as lingual surfaces of the implant <sup>(2)</sup> . To rehabilitate teeth using implants in the partially dentate arch, 3mm bone between the implant and an adjacent natural tooth is recommended to minimize the potential for damage to the supporting structures of the natural teeth. Multiple grafting techniques have been described to augment residual ridge height and width for both mandible and maxilla.

Although, excessive amounts of bone may require implant placement at different levels that can create occlusal plane interferences in the final prostheses. Also, there must be a balance between the amount of cortical and trabecular bone. Cortical bone is very dense and has a more limited blood supply that may delay the integration of implants. This may necessitate an extended time interval between surgical stages. The presence of too much loose trabecular bone may limit primary stability of an implant and may also require a longer osseointegration time<sup>(2)</sup>.

### **Maxillary arch-**

Maxilla is a pyramidal-shaped bone with the base adjacent to the nasal cavity.

Apex of the maxilla gives rise to the zygomatic arch and the body of the maxilla constitutes the maxillary sinus<sup>(3)</sup>. The anatomical structures in the maxilla that can pose as a barrier for implant placement are the nasal floor anteriorly and in the posterior region is the maxillary sinus. Iatrogenic sinus perforation is a recurrently faced hurdle when the selected implant length is not in relation to the available bone in the posterior maxillary region. The proximity of sinus is the main cause for implant failure in posterior maxillary region.

In the anterior portion of the palatal region there is the presence of the incisive foramen (or nasopalatine) that comprises of the nasopalatine vasculo-nervous bundle. Care should be taken about the size of the nasopalatine canal as it usually poses a problem while implant placement in the anterior maxillary region<sup>(1,4)</sup>. The proximity of the anterior region of the maxilla to the nasal cavity is another limiting factor, as is the maxillary sinus in the posterior region. Direct and indirect sinus lift procedures are done in the posterior maxillary regions so as to avoid sinus perforations while implant placement. One of the alternatives to sinus lift procedures is the use of short implants, which is also used for immediate implant placement. Implants with lengths of 5–8 mm are currently used and may be defined as short implants. Implants 5 mm long and 6 mm wide can be successfully loaded in maxillary bone with a residual height of 4–6 mm leaving the sinus floor undisturbed<sup>(5)</sup>. Srinivasan et al. studied the literature from 1990 to 2011 and have concluded that short implants have a satisfactory survival rate ranging between 92.2 and 100%. Although there are contradictory views as, in an earlier article, Esposito et al. have warned about the long term success of short implants<sup>(6)</sup>. Implant placement in the anterior maxilla is in a coronal section of the canine pillar region, it is possible to observe the existence of little spongy substance, the cortical bone almost completely dominates the region, making it a very favourable region for implant installation, even in atrophic maxillae<sup>(7)</sup>. However, the distribution of the implants as well as their diameter, length and type of surface are directly related to bone quality and quantities, as well as the prosthetic work to be performed on the implants.

### **Mandibular arch-**

The foremost anatomical consideration while placing an implant in the mandible is the position of the inferior alveolar canal or the mandibular canal, that houses the inferior alveolar vasculo-nervous bundle and it emits its mental nerve branches at the level of the second premolar. Iatrogenic abuse of the vital structures like inferior alveolar nerve and artery can result into loss of sensation, altered sensation, pain, excessive bleeding, etc. following implant placement. Thus, it is important to assess the location as well as the configuration of the mandibular canal before the implant placement<sup>(8)</sup>.

The location of the mandibular canal radiographically had been classified as:

- High—within 2 mm of the apices of the first and second molars
- Intermediate
- Low

Other variations can be stated as —duplication or division of the canal, partial or complete absence of canal or lack of symmetry<sup>(8)</sup>.

- A study conducted by Heasman<sup>(9)</sup> stated that in 68% of the cases, the mandibular canal traversed through the intermediate zone which is between the root apices and the inferior border of the mandible.

In a dentate individual, the distance between the root apices of first and second molars and the upper border of the mandibular canal ranges from 3.5 to 5.4 mm. Though, once the teeth are lost, the residual alveolar bone undergoes varying degree of resorption and atrophy, and this distance may vary accordingly.

Levine et al<sup>(10)</sup> conducted a study where they measured the distance between the edentulous alveolar crest and the superior aspect of the mandibular canal and concluded that the canal lied approximately 17.4 mm inferior to the alveolar crest. However, this distance can vary and hence must be assessed in each case prior to implant placement.

The location of the mandibular canal is subjected to variation even in the horizontal plane.

Kim et al<sup>(11)</sup> classified the location of the mandibular canal in the buccolingual location into three types:

- *Type 1:* Canal follows the lingual cortical plate at the mandibular ramus and body (70%).
- *Type 2:* Canal follows the middle of the ramus behind the 2nd molar and the lingual plate passing through the 2nd and the 1st molars (15%).
- *Type 3:* Canal follows the middle or the lingual 1/3rd of the mandible from the ramus to the body (15%).

Anatomical challenges, such as resorbed mandibular ridges and highly placed mandibular canal must be taken care of prior to implant placement through procedures such as ridge augmentation, bone grafts and transpositioning of the inferior alveolar nerve and artery.<sup>(12)</sup>

Presence of a large mandibular tori may give a false impression of the amount of available bone as well as hinder the outline of the mandibular canal.<sup>(13)</sup>

Complications while implant placement in the anterior mandible may arise due to implant impinging on the mental nerve or due to inferior perforation of the cortical plate. Therefore, the amount of bone resorption as well as the location of the mental nerve in the inter-foraminal region of the anterior mandible should be assessed before implant placement. 25 to 38% of cases present with the mental foramina located coronal to the premolar apex<sup>(13,14)</sup>

### **Off-axial implant placement-**

Implants placed at positions other than the vertical axis have been referred to as 'tilted implants' or 'off-axis fixtures.' These may be placed to avoid damage to various anatomical structures or to eliminate the need for bone grafting and nerve repositioning procedures. Off-axis loading of the implants results in stress on the implants and the surrounding bone, but studies have found these stresses to be within the physiological limit.

Krekmanov et al<sup>(15)</sup> recommended that posterior tilting of the distal implants in either arch may reduce cantilever length hence providing better load distribution. However, implants placed off-axis usually require angle-corrected abutments.

Rosén et al<sup>(15)</sup> followed implants in the maxilla for 8 to 12 years that were tilted to avoid grafting procedures. They concluded that this was a successful alternative procedure to more resource-demanding techniques such as bone grafting.

Krennmair et al<sup>(15)</sup> studied 62 patients with mandibular overdentures and analyzed the various angles of the implants for optimal restoration. They concluded that sagittal mandibular inclination should be given more importance than axial loading of implants.

Aparicio et al<sup>(15)</sup> followed fixed implant bridges supported by both axial and tilted implants for 21 to 87 months post-insertion and concluded that the use of tilted implants is an effective and safe alternative to the maxillary sinus floor augmentation procedure.

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