

## Factors Affecting Immediate Implant Placement in the Maxillary Anterior Region- A Narrative Review

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**ABSTRACT:** When the esthetic zone of Maxillary anterior region is to be restored, the Clinician faces a plethora of challenges which include resorption and dehiscence of buccal bone, inadequate primary stability, non-ideal placement and positioning of the implant, need for augmentation, inadequate palatal bone for Anchorage, requirement of ideal esthetics and emergence profile. The challenges of Immediate implant placement are primarily due to inadequate preoperative evaluation, errors in case selection and unavailability of bony dimensional data leading to insufficient preparation and underestimating the need for augmentation especially in immediate implantation causing failures.

Also various studies have reported a wide variance in the dimensions of the alveolar bone amongst different ethnicities and populations as we all as age and gender groups. This underreported data and a lack of a standardized operating protocol can lead to compromised results when planning for immediate implant placements. There is a need to identify the parameters of the maxillary anterior segment in our local population with a special focus on the maxillary central incisor region (common site for immediate placement of dental implant) which determine the long term success of dental implants.

Hence measurement and management of the same is important especially in immediate implantology. Studying these variables will be clinically relevant and may be helpful in determining the success of immediate Implants in maxillary central incisors. The study attempted to identify all the parameters. The study highlighted the importance of measuring and management of the parameters.

**Keywords:** Dental implant, Immediate placement, CBCT, Maxillary Central Incisors, Esthetics.

### INTRODUCTION

Indicators of implant therapy success are now no longer limited to implant survival, but also include long-term esthetic and functional success. The interaction of hard and soft tissues, which is reliant on the underlying bone anatomy, is essential for achieving pleasing aesthetic results. Dental implants are utilized frequently in modern times due to their success in both restoration and functionality. The measurement of the quantity and quality of alveolar bone is important, as it influence implant stability and esthetics. Due to their capacity to

shorten treatment times, increase patient comfort, and preserve the inherent dimensions of both soft and hard tissues, immediate implants are becoming more and more popular. Before extraction, radiographically analysing the dimensions of alveolar bone with cone beam computed tomography, crucial to determining the best course of treatment and safeguarding nearby anatomical structures. particularly in circumstances where immediate implants are indicated (Dawadi *et al.*, 2022). The rate of survival of immediate placement is between 87 to 100% depending on the loading protocol used. Immediate dental implant placement is advised

when the following clinical factors are present: intact socket walls, thick soft tissue, absence of acute infection, sufficient bone in apical and lingual/palatal areas, insertion torques of 25 to 40 N or implant stability quotient (ISQ) values >70, compliant patient and at least 1mm thickness of facial bone. As a result, there is a quicker return to aesthetics and less need for additional care (Heimes *et al.*, 2021). Mello *et al.* as compared to delayed placement of implants, immediate implants have certain advantages, including a quicker osseointegration period, less bone resorption and better aesthetic outcomes, particularly in the region surrounding the front teeth. Immediate implant placement aims to maintain the alveolar ridge while reducing recovery times, morbidity, and patient satisfaction. Additionally, it is believed to have financial and psychological benefits (Srebrzyńska-Witek *et al.*, 2018). However, there are some disadvantages to immediate implant placement as well, comparatively slightly lower survival rates, some bone loss and soft tissue loss (Alqhtani *et al.*, 2022). When using immediate implant placement, careful pre-surgical evaluation and case selection are necessary for the best functional and aesthetic results (Srebrzyńska-Witek *et al.*, 2018). In implant dentistry, the facial wall is an essential part of the aesthetic outcome. Therefore, accurate treatment planning benefits from a thorough evaluation of the labial wall before surgery. The anterior maxilla needs at least 1-2 mm of buccal bone to provide adequate soft tissue support and produce the best aesthetic results. It was suggested that the alveolar crests vertical height be preserved by requiring a buccal bony wall to be at least 2 mm wide (Alqhtani *et al.*, 2022). Additional surgical procedures like hard and soft tissue augmentation are required at the surgical site when there is bone atrophy and insufficient crestal width. With the help of CBCT technology and the related software, it is now simple to assess the ridge profile, including the thickness of the overall ridge, in the palatal region, and the concavity of the facial bone plate. The additional factors on which implant stability in the maxillary anterior region depends on are the length and position of root in alveolar bone. (Xu *et al.*, 2016).

## FACTORS TO BE CONSIDERED

Individuals who have buccal-type root position having thicker palatal walls and then buccal bony walls. As a result, the palatal bone wall can be engaged for immediate implant placement. Precise measurement of the position of the root of the maxillary central incisor in the alveolar bone is required for planning in immediate placement sites using CBCT. (Xu *et al.*, 2016) The thickness of the palatal alveolar bone is crucial to the immediate implant treatment protocol in order to guarantee that implants are positioned in the anterior region in the best possible location. Evaluation of tooth angulation is also required in order to select the ideal implant with the desired dimensions, foresee the requirement for bone regeneration, and make plans for upcoming prostheses. Atraumatic extraction or partial extraction therapy are two preventive methods that can help to preserve the facial bone crest. In addition, other

surgical techniques, such as minimal or flapless surgical elevation, can be used to circumvent the anatomical limitations of the thin facial bone (Ahamed *et al.*, 2022). To achieve initial stability, it was suggested that the immediate implant be positioned at least 3 mm apical to the location of the extraction and 2 mm beyond the mid-root of the palatal bone. However, clinicians must be aware of both the most extreme maxillary incisor protrusion and the region where palatal bone plate is thin (Do *et al.*, 2019). The palatal bone plate won't be broken during surgery to place implants right away thanks to this technique. The angulation of the tooth or the root must also be taken into consideration in order to properly place an implant that will support a prosthesis. The angle that is formed by the long axis of the tooth and the long axis of the alveolar bone housing with which it is associated is referred to as "tooth angulation". This measurement must be used to determine the implant's size and orientation. The previous study found that tooth angulation frequently ranges between 10° and 20°. In this kind of tooth angulation, it has been observed is most predictable and it is advisable to follow the orientation and screw-retained prosthesis is ideal. But the 1-10° group and the group with more than 20° should receive special attention because it will result in compromised situations (Rasaie *et al.*, 2022). The preferred method for treating failing teeth in the esthetic zone has been immediate implant placement and provisionalization because of its stability of soft tissue shape over time. Sagittal root position, or SRP, or the root's relationship to its osseous housing, is crucial in determining whether immediate implant placement is viable. Other anatomical factors that should be considered for dental implants in the aesthetic zone include the marginal bone thickness mesial and distally to the implants as well as the facio-lingual dimension of the papillary base because they are connected to papillary fill and gingival recession following the procedure (Rodrigues *et al.*, 2022). Bone augmentation for implant placement is frequently necessary after tooth loss due to the reduction in height and/or width of the alveolar process and the development of a labial concavity. The location of the nasal fossae's floor and the shape and size of the nasopalatine (incisive canal) are two additional variables that may affect the quantity of bone for placement of implant. The buccolingual inclination of the tooth must be carefully taken into account when choosing the best dental implant treatment plan and implant size. A thorough analysis of the orofacial ridge's anatomy, including the crest width and facial bone atrophy, is necessary before an implant is inserted. Another important criteria are selectively the longest possible implants, as the anatomy permits, to ensure maximum primary stability (Lee *et al.*, 2010).

## ANATOMICAL FACTORS

Behind the maxillary central incisors is the Incisive Canal (IC), a significant anatomical features. The canal either terminates at the nasal floor with two openings (nasopalatine foramina/foramina of Stenson) on either side of the nasal septum or travels to the nasal cavity as a single canal or is known to split into two or more

canals. In the middle of the anterior palate, below the incisive papilla, is the funnel-shaped incisive foramen. Significant structures in the canal include the nasopalatine nerve and the terminal branch of the descending nasopalatine artery. The extreme demands of the patient for complete biomechanics, phonetics and aesthetics make placing implants in the different in the anterior maxilla, as is also widely known (Sonawane *et al.*, 2022). Implant non-osseointegration and/or sensory dysfunction may occur as a result of implant placement close to the IC, which may jeopardize the success of the procedure (Rasaie *et al.*, 2022). In order to avoid these issues, it is important to evaluate the morphology. dimensions, and separation of the IC from the labial cortical plate prior to implant placement. Accurate knowledge of the IC is essential when inserting implants in the maxillary anterior region; otherwise, permanent sensory loss may occur (Sonawane *et al.*, 2022). The IC of the premaxilla is thought to be of significant anatomical importance. Edentulous subjects displayed less IC- level bone thickness compared to dentulous subjects. It follows that IC damage is more common in elderly receiving implants for missing incisors (Linjawi *et al.*, 2022).

The distance between the cemento-enamel junction (CEJ) and the alveolar crest and the angle of the buccolingual teeth should be considered when determining the best treatment plan. It is important to take into account the labial alveolar bone thickness (ABT) and buccolingual teeth angulation. The length of the labial bones and the rate of bone resorption are both determined by the angle formed in the sagittal plane between the long axis of the tooth and the alveolar bone inclination. The stability of the implant is also impacted by the angle at which it is inserted. It is also necessary to augment the crestal bone if it extends more than 3-4 mm below the free gingival margin. The root angulation, establishes the sagittal bone thickness and needs to be measured. The socket is defined by root angulation, which also directs the implant's immediate insertion (Vyas *et al.*, 2023). A root that is excessively inclined or angulated reduces the thickness of the bone along the buccal or palatal aspect, which may affect bone anchorage and, ultimately, long-term implant success. When planning an implant, it's also important to consider the thickness of the mesial and distal bones. Osseointegration is less likely to be successful in areas where there are periapical infections or inflammatory changes. The distance between the cemento-enamel junction (CEJ) and the bone crest, as well as other factors like the position of the sagittal root, may be important. In planning and expecting the treatment plan. With the exception of situations where the tooth's original position does not lend itself to optimal rehabilitation, in which case the need for palatal angulation in an adequate extraction socket can range from 5 to 30 degrees, the implant angle should match the tooth's axis angle inside the alveolar bone. The clinician will use this as guidance as they move forward in pursuing this objective (Dos Santos *et al.*, 2019).

Before the planning of immediate implants, particularly in esthetic zone, it is important to evaluate the anatomical

structures in the region. The important measurements are the dimensions of the palatal bone wall create width lateral to the site of extraction which is 3 mm apical to CEJ of adjacent teeth, alveolar ridge inclination, the periodontal health of the patient especially of the adjacent teeth dimensions of naso-palatine canal and the quantity and quality of bone beyond root apex (Dabas *et al.*, 2021).

## MANAGEMENT OF FACTORS

In Class I sagittal root position (SRP), according to Kan's classification, most of the bone is on the palatal side and the root is located close to the labial cortical plate throughout its entire length. Class I, the most common position, enables immediate implant placement with favourable aesthetic results and is frequently combined with immediate loading. Class II SRP: Because primary stability requires sufficient bone at the apex of the extraction socket, immediate implant placement won't produce an aesthetic result. If the required dimensions are unavailable, it is preferable to perform a delayed placement.

Furthermore, socket shield methods could be applied in such situations. In class III SRP the esthetic rehabilitation is severely hindered. It is opt to perform an augmentation procedure and place implants at the same time (Dabas *et al.*, 2021). The only therapeutic approach that will consistently work in this case is socket preservation. The hard and soft tissue is presented by grafting are preserved. Implants should not be inserted until sufficient host tissue has grown for a successful treatment. A single implant should be positioned in the three-dimensional ideal implant position. The implant platform should be positioned 2-4 mm apically to the anticipated mid-facial gingival margin, and it should be positioned mesio-distally at least 1 point 5 mm from the adjacent root surface. The implant should be positioned bucco-lingually with 2 mm of buccal bone and slightly palatal to the incisal edge. According to Chan and colleagues' (2014) CBCT imaging study, there was always an anterior buccal concavity of ridge before the maxillary central incisor.<sup>16</sup> Researchers found a correlation between the average value of buccal concavity depth and the presence of buccal plate fenestration. Implant angulation can successfully prevent NPC perforation in cases where the NPC initially prevents implant placement and is at the level of the incisive foramen. As a result, it is advised to consider individual+0. variations when formulating an implant treatment plan and carrying out a comprehensive CBCT analysis of the NPC (Ebenezer *et al.*, 2015). It is suggested that in narrower implant or a greater embedded angle that deviated from the axis some situations, other suitable implant characteristics, such as an increasing the embedded angle or placing a short or narrow implant. Might be chosen to prevent perforation. In cases where the implant will unavoidably protrude into the NPC, guided bone regeneration and surgically displacing of the neurovascular bundle were suggested as a way to prevent direct contact between the implant surface and the neurovascular bundle and to provide

enough bone. There is an increased the risk of perforating the cortical plates during implant placement procedures, in regions where the undercuts, which could result in serious complications, making it crucial to clinically identify them. On these sites grafting is necessary, and/or that the implant fixture needs to be placed off-axially. The amount of bone beyond the apex, buccal gap, facial bone thickness and height and gingival phenotype are significant anatomical factors that influence immediate implant placement (IIP) outcomes. The position and inclination of the tooth roots also have a big impact on IIP. Clinically relevant to this are the patient selection process, IIP osteotomy preparation, and placement. CBCT evaluation for the thickness of the alveolar bone, position of tooth and root, inclination, the expected buccal gap and the bone height, is important before planning for IIP. The position of the root and any remaining socket bone will have an impact on the 3D positioning of the implant and site of initial osteotomy. The measurement of bone beyond apex is also a critical factor as it is this region that provides the primary stability for the implant.

### PROSTHETIC FACTORS

When making decisions and planning for IIP, a variety of factors are taken into account, including the inclination of adjacent and opposing teeth, occlusion, the angle of placement, whether the prosthesis should be screw- or cement- retained, the use of angled and anatomic abutments and others (Gluckman *et al.*, 2018).

### OTHER CONSIDERATIONS

In order to provide primary stability, the International Team for Implantology Consensus Statement stressed the necessity of a facial bone wall, thick soft tissue, the absence of acute local infection, and an adequate amount of apical and palatal bone. The root length and sagittal root position (SRP) of the alveolar bone housing are two factors that should be considered when placing an immediate implant because they may affect primary stability. Other factors to be considered include the arch form, the angle between the alveolar bone and tooth axis, the size of the buccal bone, the angle of the root, the width of the socket, and the size of the buccal and palatal soft tissues. The SRP should also be evaluated in light of additional factors like alveolar dimensions, tooth angulation, palatal bone thickness, apical bone height and the presence of buccal undercuts (Rodrigues *et al.*, 2022).

Scalloped and thin gingival were allegedly more likely to experience recession, whereas the thick-flat biotype was essential for a successful aesthetic outcome following implant restoration (Zhou *et al.*, 2014). There may be a link between the labiolingual inclination of the upper incisors and the anatomy of the alveolar bone, as well as between maxillary protrusion and another facial type classification that gauges the extent of maxilla development, and these factors should be assessed before implant surgeries. The group of Spear *et al.* It was thought that the presence of a bone height of about 1 mm is necessary for papillary appearance. In order to predict

the interproximal region's cosmetic outcome, it is essential to evaluate the interproximal bone anatomy, especially its height. As suggested by Buser *et al.* the implant shoulder has to be placed 1-2 millimeters lingual to the emergence of adjacent teeth (Buser *et al.*, 2004). Creating a step on the palatal plate in the apical region of the socket using a round bur has also been suggested, rather than a straight drill. In sites with severe alveolar atrophy or a distinct defect in labial bone, in the maxillary anterior region, delaying the implant placement is the best alternative. In these sites socket grafting on guided bone regeneration could be performed depending on the anatomy of the residual bone.<sup>18</sup> It was noted that the interproximal bone height in the maxillary anterior region was greater than 1 point 5 mm. Clinicians have already been given advice on how to rebuild the bone height and keep the papillary presence, including the use of guided bone regeneration (GBR) and socket augmentation. Minimally invasive approach with bone augmentation at the interproximal region can be performed along with IIP. This reduces the chances of bone and papilla loss. Gracco and others (2009). documented the relationships between facial type, alveolar bone thickness, and placement of the upper incisors (Gracco *et al.*, 2009).

### ADDITIONAL CONSIDERATIONS

The length of a person's face (shorter face types have greater alveolar bone thickness compared to long face types), the extent of their jaw protrusion and the angle of their incisors all affect how thick their alveolar bone is in the region around their maxillary incisors. Between different ethnic populations, there are minuscule differences. Aspects like demographics, gender, tooth inclination, face soft tissue type may have an impact on the height and thickness of the type and facial plate of the alveolar bone. Inverse relationships exist between crestal labial soft tissue and buccal bone thickness. Because the behaviour of soft tissue is greatly influenced by bone thickness, which helps in preventing crestal bone loss. When adequate ridge width or height has been lost due to extractions, periodontal disease, trauma, prolonged use of removable dentures or sinus pneumatization, bone augmentation is typically necessary to restore it. Even in cases where there is no bone fenestration or dehiscence, some studies have suggested bone augmentation for better aesthetic results. When the height of the alveolar bone crest is constrained or diminished, short implants are a better option for treatment. Insufficient crest height may also have an impact on the interproximal papilla level, which could harm implant aesthetic outcomes. Gender differences must also be taken into consideration when getting ready for immediate implant placements (Sheeral *et al.*, 2019). A precise preoperative evaluation of the alveolar dimension at the intended implant site is essential for developing an appropriate placement strategy and safeguarding nearby anatomical structures, especially when an immediate implant placement is required. It has been observed that the anterior maxilla displays a general bell-shaped ridge as the alveolar width increases from

coronal to apical directions. An alveolar cortical plate perforation and surgical complications are more likely to occur if there is a buccal or lingual undercut, or it may indicate that additional grafting procedures are necessary. An implant may need to be positioned off-axially and restored with an angled abutment in order to take this anatomical variation into account. The typical alveolar dimensions at the anterior maxilla for the chosen population are 8 to 9 mm wide and 18 to 19 mm tall. Buccal undercuts of various depths and locations are present on at least one-third of the maxillary anterior teeth (Zhang *et al.*, 2015). Use of alloplastic B-Tricalcium phosphate and a resorbable collagen membrane have been used to augment bone. Several other graft materials have been used to augment the jumping distance. A combination of connective tissue graft and GBR have also been successfully performed in sites having convex labial bone. The socket shield technique is an additional tactic for stopping buccal bone loss during immediate implant insertion. Furthermore, it was discovered that flapless immediate implant placement produced greater accuracy compared to freehand surgery when transferring the implant position in the anterior maxilla using preoperative CBCT. One quarter of the cases were unsuitable for immediate flapless implant placement because the labial bony wall was absent in those situations (Lee *et al.*, 2019).

## CONCLUSION

Preoperative diagnosis and thorough treatment planning are therefore required, keeping the aforementioned factors in mind, especially when planning for immediate implant placement in the anterior esthetic zone, in order to ensure long-term stability and success.

## FUTURE SCOPE

Future studies can compare the impact of these parameters on the success of immediate implant placement in a well-designed randomized controlled trial.

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