

## Controversies in the dental implant treatment planning for anterior maxillary aesthetic zone – A review

### ABSTRACT

The anterior maxillary region being an aesthetic zone remains critical in decision-making when it comes to replacing a tooth. Treatment planning to place dental implants in aesthetic zone like anterior maxilla needs paramount attention in order to provide best of the treatment outcomes from aesthetic point of view. As the field of dental implants tend to evolve continuously, newer concepts with inadequate research come into practise on regular basis. In this article, some of the controversies regarding dental implant placement and treatment process related to anterior maxillary aesthetic zone are discussed with literature to support evidence.

**Keywords:** Anterior maxilla, controversies, dental implant

### INTRODUCTION

Dental implants have become an effective and preferred treatment modality for replacement of teeth in complete and partially edentulous jaw regions. Studies show ability of implant therapy to achieve aesthetic results of a desired level in the restoration of a missing or broken tooth with high predictability and on a long-term basis in the literature.<sup>[1-3]</sup> But however, literature show that there are limitations in some clinical situations where achieving a satisfactory outcome is still questionable on observing for a long-standing basis. As there is increasing expectations in the quality of treatment outcomes and there is continuous search of knowledge, thereby giving birth to newer interventions in order to bring demands to reality, it has become a practise to perform newer techniques and modified protocols which lack adequate evidence in literature.<sup>[4]</sup> Hence, it is crucial to justify the technique including the diagnosis, presurgical planning, and to make sure the principles of the procedure match the treatment goals with use of available evidence in the literature. The anterior maxillary region being an aesthetic zone remains critical in decision-making when it comes to replacing a tooth no longer restorable. Planning to place dental implants in aesthetic zone like anterior maxilla needs paramount attention as the evaluation begins

even before extraction of the tooth for a given case. Various factors to be considered include: (i) status of the surgical site in turn stressing on quantity and quality of bone available in case of edentulous region and bone to be preserved in case of replacing a non-restorable tooth by a traumatic extraction, (ii) presurgical planning covering the 3D analysis with dimensions of the hard and soft tissues of the surgical site, (iii) management of soft tissue based on its biotype as it plays a major role in final aesthetic outcomes, (iv) implant positioning and its relation with adjacent natural teeth, (v) implant placement protocol to be followed for the given clinical situation, (vi) necessity of additional surgical procedures like bone augmentation of deficient ridges, socket grafting for delayed implant placement protocols, connective

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**Received:** 18 April 2020, **Revised:** 13 July 2020,  
**Accepted:** 18 June 2021, **Published:** 14 April 2023

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**How to cite this article:** Singh V, Bhagol A, Ashwin V. Controversies in the dental implant treatment planning for anterior maxillary aesthetic zone – A review. *Natl J Maxillofac Surg* 2023;14:3-8.

Access this article online	
<b>Website:</b> www.njms.in	<b>Quick Response Code</b> 
<b>DOI:</b> 10.4103/njms.NJMS_59_20	

tissue grafts for deficient areas, (vii) management of surgical site associated with pre-existing pathologies/infections/impacted teeth, etc.,<sup>[5]</sup> Many treatment options in dental implant placement are introduced and constantly modified to bring better outcomes in a shorter duration of treatment.

### Controversies

As newer concepts arise, the rate of practising these protocols without adequate clarity of the indication and necessity for a given scenario has increased. The more the newer concepts arise, the more controversies arise and at times are left unproved thereby increasing the complexity of the treatment in order to achieve unrealistic outcomes. Treatment based on inadequate evidence in literature creates a potential threat when the treatment outcomes are assessed a long term basis. Some controversies of the dental implant therapy in anterior maxillary aesthetic zone like various implant placement protocols, case selection for implant placement using socket shield technique, feasibility of implant supported cantilever design prosthesis in anterior maxilla, prosthetic considerations for implant placement in anterior region are discussed in this article with supporting and opposing evidence presented.

### Various implant placement protocols

Definition of time of placement of dental implants given in ITI in 2003 and 2008,<sup>[6]</sup> broadly classified into four options which were, namely, immediate implant placement, early implant placement following soft tissue healing, early implant placement following partial bone healing, and late implant placement following complete bone healing. With inadequate literature and inconclusive evidence, the appropriate option to be chosen for a given case in aesthetic zone remains a controversy till date as each of the methods possess their own advantages and disadvantages. Late implant placement is the placement of an implant into a healed socket with expected complete hard tissue healing, which is implant placement six months to several years following extraction of the tooth. This longer duration of treatment is not necessarily favored unless supported by local site-related factors or patient-related factors.<sup>[7]</sup> Site-related factors mentioned include infected tooth with periapical infections or associated pathologies which need prior healing, hopeless tooth extracted in a growing patient, tooth loss due to trauma requiring time for hard tissue healing, etc. whereas patient-related factors include comorbidities of patient delaying from undertaking a surgical procedure, pregnancy during the time of extraction, and other personal reasons for delaying the time interval from extraction and implant placement. In anterior maxillary region, delayed implant placement provides the advantage of availing superiority in terms of quality of bone as the implant are placed following complete bone healing and

proper positioning of drills resulting in ideal or near to ideal angulation of the implants needed for prosthetic restoration. Angulation of the implant placed serves major criteria when it comes to deciding overall treatment outcomes such as life expectancy and in terms of aesthetics. Author rewrites increased life expectancy which simply is due to reduction of crestal bone loss as there is adequate buccal bone wall due to better placement of implant at mid of available bucco-palatal width, ability to optimize provisionalization of the restoration as there is better angulation of the implant placed in terms of proclination, osseointegration achieved, ability to design prosthesis with optimal occlusal load on the implant and the hard and soft tissue support provided. Although the bone quality for implant placement is superior in this mode of placement, the bone loss to occur following extraction is accountable, reducing the available height of the alveolar ridge which quantifies the outcome in replacing tooth in anterior maxillary aesthetic zone. To counteract this loss of architecture, it is advised to go for socket preservation or bone augmentation<sup>[8]</sup> which is placement of bone-like graft materials into the socket following tooth extraction as and when required. Socket preservation prevents marked bone loss and disfigurement of the socket<sup>[9-11]</sup> but selection of the graft materials to be used remains a controversy. While some studies suggest osteogenic grafts such as autogenous bone, other studies argue that the purpose of grafts is to maintain the socket volume and hence preferring the placement of graft materials with low substitution rate which act as scaffold to maintain the volume during the period prior to implant placement.<sup>[12-15]</sup> The autogenous bone grafts provide lesser graft rejection but it poses the secondary donor site morbidity when it comes to need for a larger augmentation whereas xenografts pose challenge of graft rejection and mismatched duration between bone healing and resorption of the same. Either of the grafts have showed predictable results on a long term basis.<sup>[16-19]</sup> On summarizing the benefits and disadvantages of delayed implant placement, this aforementioned method pulls a major shortcoming which is the increased duration of treatment period and edentulism which is to be accounted when it comes to anterior maxillary region. Since the treatment duration and period of edentulism is longer, this treatment option remains one of the less preferred from patients point of view. Considering the time interval, then comes the concept of early implant placement with soft tissue healing (type 2) and with partial hard tissue healing (type 3) which was developed in the late 1990s.<sup>[6]</sup> In this method, a 4–8 week healing period is given following extraction before implants are placed. During this period, healing of soft tissue takes place thereby availing keratinized mucosa covering the socket which helps during implant placement by reducing postsurgical complications.

Also there is resorption of bundle bone in this wound healing period. In a study,<sup>[20]</sup> it was demonstrated that there was marked increase in the thickness of soft tissue in mid-facial region offering several advantages such as a thick mucoperiosteal flap for implant placement, improved vascularity of soft tissue, and partial healing of the socket from apical region thereby providing a bone bed superior to that of a fresh socket. Immediate placement of implants at the time of extraction provide an added advantage to the patient in terms of decreasing the overall treatment duration and thereby satisfaction provided optimal treatment outcomes are achieved. Many studies argue that immediate placement of implants reduce the alveolar bone resorption which serves the major factor in deciding the treatment outcomes in the anterior maxillary aesthetic zone. This supports the views of preferring immediate placement over the other as it reduces the additional bone augmentation procedures. At the same time, questions rise on the potential advantage of preferring immediate placement due to other factors such as inadequate primary stability achieved, improper to a compromised positioning of the implants causing difficulty in prosthetic rehabilitation in later stages all together reducing the optimality of treatment outcomes. Implants placed immediately following extraction tend to engage bony wall only in the apex region as coronal part of the socket is barely affected by the preparation and mostly the region between implant and the coronal part remains to get filled following osseointegration by the end of the healing phase.<sup>[21]</sup> This difference in engagement of implant along its surface with the bone between immediate and delayed implant placement and subsequent effects on the healing during osseointegration and the survival rate remains a deciding factor to focus on the treatment option to be chosen.<sup>[22]</sup>

#### Case selection for implant placement using socket shield technique

Restoration of aesthetics in anterior maxillary aesthetic zone remains a big challenge since ideal preservation or reconstruction of the peri-implant architecture in that region is difficult and possible only in selected cases. Various factors<sup>[23]</sup> leading to this aesthetic compromise can be recession of gingiva vertically in mid-facial and interdental area with loss of facial contours associated with changes in color and texture of soft tissues differing to that of natural teeth. These changes are primarily due to the inevitable loss in the architecture which is comparatively more in anterior maxilla as this region more liable to hard and soft tissue changes than any other regions of the dentition. Several factors such as mechanical trauma caused during extraction, microbial load in the site of surgery, vascular compromise due to flap elevation and subsequent loss of periodontium and some general factors such as patient-related comorbidities, smoking or

plaque accumulation and oral hygiene maintenance cause impact on the sequel of events to follow.<sup>[24]</sup> Some studies reported that the depth of deterioration and architecture loss depends on two important factors namely the thickness of the buccal bone wall and the loss of periodontium in the anterior maxillary region.<sup>[25-27]</sup> In order to overcome the impact of physiologic response following extraction and its effect on the osseointegration of the implant and the aesthetic appearance, socket shield technique was considered, and efforts including simultaneous hard and soft tissue augmentation procedures, flapless approaches and modifications of the technique were carried out making use of the technique to reach best possible aesthetic results.<sup>[28]</sup> Even though numerous advances of the technique were made it has to be realized that meeting treatment outcomes are possible only in selected cases.<sup>[29]</sup> Since the tissue remodeling cannot be completely prevented or compensated.<sup>[28,30,31]</sup> Even though there are upcoming reports in the literature to support evidence regarding the successful survival of implants using this technique with additional advantages such as betterment in aesthetics at follow-up and lowered need for bone augmentation and surgical procedures, the technique shows its limitation in terms of its application when it comes to case selection and associated technique sensitivity. The case selection primarily depends on the cases indicated for immediate implant placement with no pre-existing infection or pathologies associated with the tooth. Since this technique focuses on nullifying the effects of extraction on the buccal bone wall, it is necessary for the buccal segment of the tooth root to remain in a condition to be left within the socket.

#### Cantilever design in anterior maxilla

Treatment planning of replacing two adjacent missing teeth in the anterior maxillary region at times becomes crucial when the interdental distance is inadequate and tends to pose a challenge for implant reconstruction. Maxillary lateral incisors are relatively smaller in dimension and often their roots are found tilted away from the central incisors and hence replacement of central and lateral incisors with individual implants often result in the implants becoming close<sup>[32]</sup> to each other encroaching the biologic inter implant distance required for the bone to survive. Also, when the space in the edentulous region is not adequate, individual implants with prostheses designed centered to their corresponding implants cause aesthetically unsatisfying results. Such clinical situations create a dilemma in terms of selection of implant size, inter implant distance to be left and further provisionalization of prosthesis and thus remain a controversy leaving behind cantilevering as a treatment choice. Also, there are reports of gingival recession of 1 to 2 mm of the interdental papillae with lack of natural teeth on

either sides, when adjacent teeth are extracted.<sup>[33]</sup> Tarnow in 2000,<sup>[34]</sup> reported that implants placed closer to each other separated by less than 3 mm of space show crestal bone loss affecting the height of the inter-implant bone. These more than allowed amounts of vertical bone loss in turn lead to soft tissue recession in vertical dimension thereby affecting the aesthetic outcomes. This significant interdental papillary recession, inability to maintain oral hygiene due to tightly placed prosthetic units and any compromise in the prosthetic design are few factors which lead to unimaginable aesthetic disasters in anterior cases with adjacent missing teeth. Even though aforementioned factors favor the operator to decide for a cantilever prosthesis, cantilevers have their own limitations. In a study<sup>[35]</sup> in 2007, it was reported that the prosthodontic rules such as advised crown-root ratios for replacing missing tooth does not seem to apply similarly for an implant supported prosthesis. Wennstrom *et al.*<sup>[36]</sup> 2004, reported that cantilever designs are better tolerated by implant supported prosthesis comparative to natural teeth up to a given limit. When cantilever designs are designed for adjacent missing tooth of longer duration, they can be backed by a soft tissue corrective surgery for better aesthetic results, which can produce over 6 mm of tissue height over the receded alveolar ridge.<sup>[33]</sup> However, cantilevers should be limited to situations demanding a smaller span length with lesser masticatory forces we should not be cavalier with designs that increase force production in implant prostheses. Since teeth in the anterior maxilla are often small, cantilevers can be made relatively short to minimize the force on the prosthesis, implant, and bone. Also, the prosthesis can be placed in a desired occlusion in such a way to further reduce the forces on the cantilever.<sup>[32]</sup>

### Prosthodontics considerations for implants placed in anterior maxillar aesthetic zone

The success of treatment outcomes and survival of implants widely depend on the treatment plan and the mode of placement and protocol followed. However, the aesthetics and the enhancement of final results are achieved only on appropriate placement of prosthesis. Since there is continuous tissue remodeling and the extent of changes are not definable,<sup>[37]</sup> what appears to be a satisfactory outcomes tend to gradually gain attention from patients view point. Selection of the proper surgical approach may enhance the overall result. Major consideration for prosthetic part in anterior maxillary aesthetic zone is the method of provisionalization which can be immediate or delayed combining with the surgical approach followed for a given case.<sup>[21,38-40]</sup>

### Provisionalization

Provisional restorations offer number of advantages whereas improper selection of provisional restoration at times can

lead to serious deteriorating effects on the peri-implant architecture. Hence, it is very necessary to understand the concept of provisional restoration as the placement of same affects in many factors such as method chosen, time, and duration of placement, material used for fabrication, etc. Provisional restorations are fabricated either to maintain or recreate the hard and soft tissue architecture around the implant to receive a definitive restoration in order to achieve optimal results on a long-term basis.<sup>[37]</sup> In anterior maxillary region purpose of provisional restorations is to primarily aid in preparation of contour and shape and guide healing of the peri-implant soft tissues till final resoration is given. Additionally, such provisionalization allows better understanding of aesthetic demands and idea about the outcomes which can be achieved well before the final treatment along with added advantage for the patient during expected period of edentulism<sup>[41]</sup> provisional fixed-partial dentures removable partial dentures, denture teeth with vacuum-formed matrices, resin-bonded restorations include the methods for provisional restorations in anterior maxilla.<sup>[42]</sup> Literature reports recession of peri-implant soft tissues accounts approximately of 0.8 to 1.4 mm<sup>[38,43]</sup> following a second-stage surgery or when immediate loading is done after implant placement. First three months following surgery remains a vulnerable as majority for remodeling occurs in this period. Hence, author stresses on selection of appropriate timing for optimal results and success. An appropriate emergence profile is necessary with only which a natural appearance of the prosthesis can be achieved.<sup>[39,43-45]</sup> Apart from the crestal bone, the contour of gingiva can gain additional support from a properly placed subgingival abutment as the gingival contour and the presence or absence of interdental papillae majorly depend on the subgingival component of abutment and crestal bone height and contact bone of adjacent tooth. Resin bonded provisional restorations give the provision of interchanging to a screw-retained restoration following bone healing phase and thus provide additional advantage of comfort and ease of adaptation to the patient and offer better support to the peri-implant soft tissue in achieving contour and shape.<sup>[40,44,46,47]</sup>

### Screw-retained versus cemented crown

The choice of fabrication of the crown either screw-retained or cement-retained carry a completely different set of indications, and still the decision completely depends on the preference of dentist. The choice of method in anterior maxillary region remains crucial as both the methods have narrowed chances of impact on the aesthetics. While screw-retained prosthesis are to be preferred only when there is situation of having the long axis of implant and the screw access fall in one line coinciding with palatal surface of restoration without affecting the

bulk that can be provided, cement-retained prosthesis allow margin of correction when implant angulation does not favor the usage of straight abutments. In case of screw-retained prosthesis, the method of fabrication differs in such a way that the porcelain fused directly with the casted metal and a major shortcoming of this design lies on the chances of ceramic getting chipped<sup>[37]</sup> of at the margins where less bulk offered and continuity of porcelain is abrupt. They also provide an added advantage of ease in retrieval and reassessment of prosthesis when needed and chances of contact of cement with peri-implant tissues are negligible.

Cement-retained restoration on the other hand reduces the frequent removal of provisional restorations thus reducing the gingival trauma caused and can be used on customized abutment invariably to the angulation of implants provided.<sup>[38,48]</sup>

### Definitive restoration

The definitive implant supported crown can be fabricated after osseointegration of the implant and stabilization of the peri-implant tissues with proper contouring of the gingival architecture. All-ceramic crowns are increasingly used to restore anterior single implants because of their excellent aesthetic properties. Clinical studies have investigated choice of material, manufacturing of copings, aesthetic results, modes of cementation, and long-term success rates.<sup>[49-52]</sup> Because most available crown systems fulfil the requirements for single-tooth implant restorations, the choice of material depends on the preferences of the practitioner and the skills of the dental technician to provide the patient with the best possible result.

### CONCLUSION

Dental implants attained the status of one of the most preferred treatment protocol for replacing missing teeth. As new protocols arise in order to make the treatment modality more cost-effective, less time consuming, less invasive with simultaneous trials to improve the survival rate, and patient satisfaction, a standard has to be set for practising new procedures modestly in order not to breach the ethical principles associated with the treatment. Even with the available indications and controversies rising in numbers, the prime authority lies with the operator in choosing the treatment approach keeping patient welfare as the first priority. This article reviews few of the controversies and as newer literature tends to evolve continuously, it is necessary for the readers to attain awareness and knowledge to constantly modify the approach and technique most appropriate and best suits for a given situation.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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