

TREATMENT PLANNING DENTAL IMPLANTS IN THE ANTERIOR MAXILLA USING A RESTORATIVE DRIVEN PROTOCOL

Dr Rahul J, MDS¹, Dr Elizabeth Issac, MDS², Dr Anoop Paulose, MDS³

1. Associate Professor, 2, 3. Assistant Professor.

1. Department of Prosthodontics, Malabar Dental College and Research Centre, Edappal, 2. Department of Conservative Dentistry and Endodontics, Sree Mookambika Dental College, Kulashekaram, 3. Department of Prosthodontics, Mar Baselios Dental College, Kothamangalam.

ABSTRACT

The anterior maxilla has always been a pressure point for clinicians for placement of functionally active and esthetically pleasing implant restorations. This is mainly due to the fact that numerous factors influence the final outcome like the bone width, length, defects, soft tissue parameters like thickness, marginal attachment, tissue defects etc. A number of modifications such as using a restorative driven protocol, performance of a risk assessment and addressing factors that could compromise esthetic success, as well as use of bone and soft tissue grafts to ensure adequate tissue volume as well as an understanding of timing with respect to implant placement have all contributed to achieving esthetic success in the region. This article reviews of some those concepts, and how they can contribute to dental implant esthetic success in the anterior maxilla.

Keywords: anterior maxilla, dental implant, restorative protocol.

INTRODUCTION

The esthetic challenges that are faced in the anterior maxilla are numerous to the fact that the end result will have to satiate both the harmonious syncing of the implant restoration to the adjacent natural state of the dentition, be it the soft tissues or the positioning of the implant but also the high expectancy of the patient as it is an anterior tooth which in itself acts as a soul to the entire face.

So this isn't any cakewalk for the dentist ;considering the dental implant positioning in the apicocoronal, mesiodistal and buccolingual dimensions as well as cor-

rect angulations of implants, the various soft tissue and hard tissue augmentations, use of provisional restorations to contour soft tissue around implants in preparation for definitive implant restorations ,as all these approaches ensures that the clinician sees the endgame in perspective ,that is the final implant restoration blending with the surroundings seamlessly.

PARAMETERS IN MAXILLARY ANTERIOR TREATMENT PLANNING

A) Patient selection and smile line

Patient selection is of the utmost importance as there are several limiting factors that may tamper the result of the restoration like the time given to the clinician, the financial position of the patient; as the treatment progresses additional expenses will incur due to augmentation procedures or other iatrogenic factors which cannot be accurately accessed in the beginning.¹

The patient's esthetic preferences should also be accessed as in an average smile 75-100% of the maxil-

Author for Correspondence:

Dr. Rahul J, MDS

Associate Professor, Department of Prosthodontics, Malabar Dental College and Research Centre, Edappal, India – 679582

Email: jayakumar.rahul@gmail.com

Mobile Number: +91 9645454284



lary incisors and the interproximal gingiva is displayed. In a high smile line additional gingival tissue is exposed. Less than 75% of the incisors are exposed in a low smile line. A high smile line poses considerable challenges when planning for implant supported restorations in the aesthetic zone because the restoration and gingival tissues are completely displayed.²

So additional surgical and restorative measures have to be taken into consideration depending on each individual.

B) Assessing dental implant positioning

To position dental implants in the mesiodistal dimension, the goal is to have a minimum of 1.5 mm distance between adjacent roots of natural teeth and dental implants, and a minimum of 3 mm between adjacent dental implants. The positioning in the buccolingual dimension requires that the implants should be placed 1 mm palatal to an imaginary line at the point of emergence profile of adjacent teeth to the implant site. Improper mesiodistal positioning of implants can also have a substantial effect on the generation of interproximal papillary support as well as on the osseous crest of the adjacent tooth.^{3,4}

THE APICO-CORONAL DIMENSION

The apico-coronal positioning of the implant is the vertical discrepancy between the occlusal surface of the implant and the peaks of the bony septa proximal to the adjacent teeth, the most pleasing aesthetic result occurs when this discrepancy is minimal. Errors in apico-coronal implant placement can have serious aesthetic and biomechanical implications. An implant placed too coronally will not allow adequate transition from the head of the implant to the point where the restoration exits from the free gingival margin.³ The restoration will look short in comparison to the contra lateral tooth.

Clinically if an implant is placed too apically with excessive countersinking procedures an unnecessary amount of bone loss will occur. Because this bone loss takes place circumferentially it will affect not only the proximal bone structure but also the height of the facial bone wall and can lead to undesirable soft tissue contours.⁵ A practical problem in placing an implant too deep is access for instrumentation. The literature shows that removing all the cement when an implant is placed so deep can prove to be a difficult endeavor. Agar et al. found that when six experienced investigators were asked to remove cement there was a surprising amount of ce-

ment left behind, these can lead to serious soft tissue complication.⁶

The facio-lingual dimension, sometimes the tooth may be positioned too far facially; this often results in very thin or nonexistent labial bone. This error results in excessive resorption of the supporting osseous structure resulting in a restoration that will appear long. A tooth positioned more lingually would benefit from the presence of an increased amount of facial bone. Implants placed too palatal complicate development of hygienic contours. Biomechanical complications can also arise as a result of cantilever forces on the screw joint of external hex systems.^{7,8}

The crest width needs to be examined to determine the presence or absence of bone atrophy. Placement will vary depending on the mechanism of retention of the final restoration (screw retained vs. cement retained). Deficient alveolar crest width may require augmentation so that the implant can be positioned in the correct faciolingual position.⁴

C) Root position of the adjacent teeth

Teeth with root proximity also possess very little interproximal bone; this thin bone creates a greater risk of lateral resorption which will decrease the vertical bone height after extraction or implant placement.⁹ When teeth are present the use of orthodontics serves as a valuable adjunct to create space. So prior planning using radiographic and orthodontic support in this area will create a more positive outcome to the final treatment.

D) Biotype of periodontium

Characteristics of the soft tissue biotype will play a prominent role in final planning for the shoulder position of the implant. A thin biotype with highly scalloped tissue will require the implant body and shoulder to be placed more palatal to mask any titanium show through. When implants are placed toward the palate a slightly deeper placement is required to allow for proper emergence profile. The thick flat periodontal biotype is characterized by a denser more fibrotic soft tissue curtain, a flat thicker underlying osseous form and an increased quantity and quality of attached keratinized gingiva. This tissue often reacts to insults by pocket formation.¹⁰ This biotype is the more favorable one considering it weathers out the insults received to it with the least amount of

recession.

E) Maxillomandibular Arch Relationship: Prosthetic Consideration

Arch relationships often are affected in edentulous ridges due to the faciolingual direction of resorption. As a result, implants often need to be placed more lingual in comparison to the original incisal tooth position. The final restoration is subsequently over contoured facially to restore the incisal two-thirds for improved esthetics. This results in a cantilevered force on the anterior implant body.¹¹

Anterior cantilevered crowns often require additional implants splinted together and an increase in the antero-posterior (A-P) distance between the most distal and most anterior implants to compensate for the increased lateral loads and moment forces, especially during mandibular excursions.¹²

An anterior cantilever on implants in the mandibular arch may correct an Angle's skeletal Class II jaw relationship.¹³ To counteract this force multiplier, the treatment plan is modified by:^{14,15}

- 1) Increase in implant number, size, and surface area of design
- 2) Increase in A-P distance between splinted implants
- 3) RP-4 restoration may be indicated, rather than a FP-3, to prevent food impaction and to facilitate daily care.

Because the edentulous premaxilla resorbs toward the palate, a Class III relationship is often observed. However, these patients often do not exhibit Class III mandibular mechanics (primarily vertical chewers with little to no anterior excursions during mastication or parafunction). Additional splinted implants in the maxilla are advocated with the widest A-P distance available. This usually requires sinus graft procedures to be incorporated into the treatment plan.

PREOPERATIVE RISK ASSESSMENT

This includes taking a detailed medical history of the patient, including chronic systemic conditions, smoking and radiation therapy. Also assess the amount of expectation the patient has from the treatment outcome considering the various compromising factors involved, as it can gravely affect the final outcome. This is then followed by an extraoral exam that evaluates general parameters such as facial symmetry, midline, the orientation of oc-

clusal plane, presence of lip support, assessment of smile width and smile line. The patient's facial appearance should be documented with preoperative extraoral and intraoral photographs. The initial consultation should also serve to educate and orientate the patient. Visual aids (such as educational models, photographs, and videos) and printed literature are useful in this regard.¹⁶⁻¹⁸

An intra-oral examination is also completed as part of the pre-operative risk assessment. This allows for an assessment of the overall gingival and mucosal tissue. This is followed by an occlusal assessment which allows assessment for parafunctional habits and bruxism, as well as evaluation of the interocclusal space in the edentulous site. This usually is accomplished after obtaining study models, utilizing mounted casts and diagnostic wax-ups.¹⁹

An acceptable clinical examination and an appropriate radiographic examination are mandatory before every implant surgery. Diagnostic imaging and techniques help develop and implement a cohesive and comprehensive implant treatment plan.²⁰ The purpose of implant imaging is to provide accurate and reliable diagnostic information on the patient's anatomy at the proposed implant sites. CT scan x-rays are usually combined with bone sounding in order to evaluate bone width, height, length and density at the dental implant site. CT scan X-rays can also be able to detect changes in bone anatomy such as dehiscence and fenestrations, as well as concavities in bone. Around implants biologic width was found to be composed of the sulcus/peri-implant sulcular epithelium, peri implant junctional epithelium, oral epithelium and connective tissue consisting of a distance of about 3.08 mm with usually a range of 3-4 mm, unlike biologic width of about 2.04 mm around teeth, its violation can result in potential for bone loss.^{21,22}

Immediate Implants Placement; In cases in which implant placement is required in a highly aesthetic zone, in a patient with high smile line, immediate implant placement is contraindicated. This is especially when a thin scalloped gingiva is present.¹⁹

TIMING OF DENTAL IMPLANT PLACEMENT

Funato and Salama et al. evaluated the timing of dental implant placement.²³

Class 1: involves intact buccal bone with thick soft tissue phenotype and immediate placement of dental im-

plant utilizing a flapless technique is usually completed.

Class 2: involves intact buccal bone with thin gingival phenotype which requires immediate placement with soft tissue graft or a secondary soft tissue graft after placement.

Class 3: involves buccal bone with bone loss that may have implant placement with bone augmentation and guided bone regeneration depending on the extent of buccal plate loss. If extensive, then they recommend a delayed approach.

Class 4: involves delayed dental implant placement with bone and soft tissue augmentation in which CT scan X-rays and three-dimensional planning with surgical guides are needed for dental implant success.

Another school of thought refers to two types of timing protocols;^{24,25}

TYPE 1 PLACEMENT PROTOCOL;

In this protocol, the implant is placed in the extraction socket at the time of extraction. The advantages are as follows:

1. Reduced overall treatment time
2. Optimal space available to place the implant
3. Only one surgical procedure
4. Minor defects in socket may be favorable for simultaneous implant placement and grafting.

THE DISADVANTAGES ARE AS FOLLOWS:

1. Lack of adequate available bone apical to socket may compromise primary stability
2. Facial malposition of implant is a common complication as the implant gets drifted toward the path of least resistance (labial cortex) during drilling. This is further complicated by presence of thick palatal cortex that pushes the drill more toward the labial side.

TYPE 2 PLACEMENT PROTOCOL;

In this protocol, the implant is placed in typically at 6 to 8 weeks after the extraction.

The advantages are as follows:

1. Additional soft tissue volume enhances chances of tension-free closure and thus allows use of regenerative materials with simultaneous implant placement
2. Resolution of pathology associated with extracted tooth can be assessed

3. Flattening of facial bone wall facilitates external surface grafting with low substitution rate bone fillers

4. Dehiscence defects on facial wall present as 2 or 3 walled defects at this stage as compared with 6 months after extraction. They are thus more conducive to regenerative techniques.

The disadvantages are as follows:

1. Two surgical procedures
2. Need for adjunctive CT grafts in most cases
3. Morphology of socket may compromise implant stability

CONCLUSION

The anterior esthetic zone as we can see is deeply layered with deep intertwining of hard tissue and soft tissue factors which occlude in every aspect of treatment planning. So, to our best efforts it is mandatory to bring these two aspects into the implant prosthetic planning so that a smooth transition from surgical to prosthetic phase be achieved. That too achieved in the least time possible taking into account the timing protocols we have seen former; which can be utilized based on individual patient parameters as and when required. So for all these envelopes of knowledge to work together we need a dicey treatment planning protocol based on the final prosthetic outcome as shown in this review, withholding all the shortcomings of this review it is still imperative that further deep analysis is done on this protocol to fine tune it more to the efficiency of the clinician and towards the rehabilitation of the patient.

REFERENCES

1. Jivraj S, Chee W. Treatment planning of implants in the aesthetic zone. *Br Dent J.* 2006 Jul 22;201(2):77-89
2. Tunkiwalla, Bhakti & Tunkiwalla, Ali. Timing of Implant Placement in Anterior Zone: A Clinical Perspective. ; *International Journal of Oral Implantology & Clinical Research.* 2011; 2(3): 176-180.
3. Chen ST, Wilson TG Jr, Hammerle CH. Immediate or early placement of dental implants following tooth extraction. Review of biologic basis, clinical procedures and outcomes. *Int J Oral Maxillofac Implants.* 2004;19 Suppl:12-25
4. Den Hartog L, Slater JJ, Vissink A, Meijer HJ, Raghoobar GM. Treatment outcome of immediate, early and conventional single-tooth implants in the aesthetic zone: A systematic review to survival, bone level, soft-tissue, aesthetics and patient satisfaction. *J Clin Periodontol* 2008;35(12):1073-86.
5. Saadoun AP, LeGall M, Touati B. Selection and ideal tri-dimensional implant position for soft tissue aesthetics. *Pract Periodontics Aesthet Dent.* 1999 Nov-Dec;11(9):1063-72;

6. Agar JR, Cameron SM, Hughbanks JC, Parker MH. Cement removal from restorations luted to titanium abutment with simulated subgingival margins. *J Prosthet Dent.* 1997 Jul;78(1):43-47.
7. Tarnow D P, Cho S C, Wallace S S. The effect of inter-implant distance on the height of inter-implant bone crest. *J Periodontol* 2000; 71: 546-54
8. Nkem Obiechina. Treatment Planning of Dental Implants in the Anterior Maxilla; Risk Assessment and Review of Soft Tissue along with Bone Preservation and Augmentation Techniques for Successful Clinical Outcomes. *OHDM* April 2019;18(2).
9. K.V.Swathi. Immediate Implants Placement-A Review. *J. Pharm. Sci. & Res.* 2016; 8(11): 1315-1317
10. Jain AR, Nallaswamy D, Ariga P, Philip JM. Full mouth rehabilitation of a patient with mandibular implant screw retained Fp-3 prosthesis opposing maxillary acrylic removable over-denture. *Contemp Clin Dent.* 2013;4:231-5.
11. Gowd MS, Shankar T, Ranjan R, Singh A. Prosthetic Consideration in Implant-supported Prosthesis: A Review of Literature. *J Int Soc Prev Community Dent.* 2017 Jun; 7(Suppl 1): S1-S7.
12. Kois JC. Esthetic extraction site development: The biologic variables. *Contemporary Esthetics and Restorative Practice.* 1998;2(2):1-6.
13. Brosky ME, Koriotoh TW, Hodges J. The anterior cantilever in the implant-supported screw-retained mandibular prosthesis. *J Prosthet Dent.* 2003; 89:244-9
14. Drago C. Ratios of Cantilever Lengths and Anterior-Posterior Spreads of Definitive Hybrid Full-Arch, Screw-Retained Prosthesis: Results of a Clinical Study. *J Prosthodont.* 2016 Jul 14.
15. Misch CE. *Dental Implant Prosthetics.* 2nd ed. Amsterdam, Netherlands: Elsevier Health Sciences; 2014.
16. Levine RA, Guy HB, Cochran DL. Soft tissue augmentation procedures for mucogingival defects in esthetic sites. *Int J Oral Maxillofac Implants.* 2014;29 Suppl:155-85
17. Bal A, Dugal R, Shah K, Mudaliar U. Principles of Esthetic evaluation for anterior teeth. *Journal of Dental and Medical Sciences.* 2016; 15: 28-38.
18. Al-sabbagh M. Implants in the esthetic zone. *Dent Clin North Am.* 2006 Jul;50(3):391-407.
19. Buser D, Bornstein MM, Weber HP, Grütter L, Schmid B, Belser UC. Early implant placement with simultaneous guided bone regeneration following single-tooth extraction in the esthetic zone: A cross-sectional, retrospective study in 45 subjects with a 2- to 4-year follow-up. *J Periodontol* 2008;79(9):1773-81
20. Shannoun F, Blettner M, Schmidberger H, Zeeb H. Radiation protection in diagnostic radiology. *Dtsch Arztebl Int.* 2008 Jan; 105(3): 41-46
21. Dawson, Anthony / Chen, Stephen. *The SAC classification in implant dentistry.* Quintessence Publication Co Ltd, 2009, Germany.
22. Funato A, Salama MA, Ishikawa T, Garber DA, Salama H. Timing, positioning, and sequential staging in esthetic implant therapy: a four dimensional perspective. *Int J Periodontics Restorative Dent.* Aug 2007;27(4):313-23
23. Thilander B, Odman J, Jemt T. Single implants in the upper incisor region and their relationship to the adjacent teeth. An 8 year follow up study. *Clin Oral Implants Res* 1999; 10: 346-355.
24. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. *International Journal of Oral and Maxillofacial Implants.* 2004; 19: 43-61.
25. Atsuta I, Ayukawa Y, Kondo R, Oshiro W, Matsuura Y, et al. Soft tissue seal around dental implants based on a histological interpretation. *J Prosthodont Res.* 2016 Jan;60(1):3-11

