

Modern prosthodontic implications of dental implants in aesthetic zone: A review.

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Abstract

Objective: Assessment of dental implant placement with prosthetic rehabilitation in the anterior aesthetic zone.

Background: Bone loss, periodontal disease and trauma affect both soft tissue and hard tissue. It is essential for any successful implant reconstruction to have an acceptable prosthesis and healthy surrounding soft tissue.

Method: A collective information from reference articles were studied. Information about smile line, 3-dimensional placement of dental implant and prosthesis were evaluated. The concept of immediate implant with prosthesis in anterior aesthetic zone is also described. The pink aesthetic score is revised and its implementation is also explained.

Results: Based on these analyses, a method is proposed for dental implant emplacement in anterior aesthetic zone. Compilation of the information can be used to guide the clinician for reconstruction of anterior aesthetics with dental implant

Conclusion: This review article compiles the techniques of surgical and prosthetic restoration using dental implants. A 4D concept using time as a variable is an important tool for 3-dimensional reconstruction of prosthesis with dental implant in anterior aesthetic zone.

Application: Most applications of the above information mentioned can be used for a successful dental implant placement with prosthetic rehabilitation in anterior aesthetic zone.

Keywords: Aesthetic restoration, gingival biotype, immediate implant, pink aesthetic score.

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Submitted: 28-May-2023 **Revised:** 12-Jun-2023 **Accepted:** 02-Jul-2023 **Published:** 15-Aug-2023

Bibliographic details: Journal of Orofacial Rehabilitation Vol. 3(2), Aug 2023, pp. 17-25.

Introduction

Dental implant treatment in anterior aesthetic segment depends on a harmonious interdependence between the prosthetic rehabilitation of dental implant and the remaining teeth. Reconstruction of natural look alike tooth with implant restoration not only depends on the ideally placed Osseointegrated implant but also on the designing of a natural gingival architecture surrounding the implant that is well suited with the smile line and face.^[1]

It is a challenging task for the clinician to replace multiple missing teeth in the anterior segment if the surrounding surface of bony architecture and the soft tissue is not sufficient. In this instance, the bony enclosure would require enlargement to generate a layout that allows the dental implant placement in that region, which ultimately produce aesthetically acceptable results.

2. Treatment planning of dental implants in esthetic zone

Aesthetic outcome of an implant supported prosthetic reconstruction depends on many factors:

2.1. Process of selecting patient and smile line designing:

Patients willing to replace a tooth in anterior region with implant supported prosthesis must be explained the various advantages of implant therapy. Conservation of the adjacent teeth is the key to successful single tooth implant reconstruction as it will decrease the rate of ridge resorption (Figure 1).^[2]

Along with lip activity and lip length, a patient's aesthetic considerations need to be assessed. The interproximal gingiva and 75–100% of the maxillary incisors are visible in a typical grin.

Low smile line – visible upto incisal edges of the tooth.

Medium smile line – visible upto interpapillary gingiva and cervical area.

High smile line – visible upto attached gingiva.

Treatment planning of dental implant supported prosthesis in the anterior aesthetic segment is done according to patient's smile line.

2.2. Three-dimensional tooth position:

Three dimensions are: apicocoronal, mesiodistal and faciolingual

A) Apico-coronal:

From a clinical point of view, if a hopeless tooth is extracted which is positioned ideally or apically then migration of gingival margin to apical aspect is evident. Aesthetic result is compromised due to long clinical crowns, visible metal margins or pink porcelain. Orthodontic extrusion before extraction is done to benefit the position of gingival tissue at a more desirable level (Figure2).^[3]

b) Facio- lingual:

Orthodontic extrusion of too far facially placed teeth with extremely little or no labial bone is not acceptable because the cardinal bone will be lost. If these teeth are pulled, there will be a large loss of vertical bone, which will then cause the gingival architecture to collapse. In this instance, operations for bone augmentation are carried out before implants are inserted. There is a likelihood that more facial bone will be present if a tooth is positioned lingually. minor differences in the face free gingival margin are present.

c) Mesio-distal:

The mesiodistal dimension for restoring a tooth should be equivalent to the contralateral tooth for a satisfactory cosmetic result, so it is necessary to carefully analyze the propinquity of the neighbouring teeth that are providing the necessary assist and size of the papillae in interdental segment (Figure 3 and 4).

2.3. Inter radicular space for implant placement:

Root position of adjoining teeth can be evaluated by cone beam computed tomography (CBCT) or radio-visio-graphy (RVG). Tilted roots of the adjacent tooth will affect the placement of implant. Teeth with juxta positioned root will lack interproximal bone which tends to resorb after implant placement (Figure 4 and 5).^[4,5]

2.4. Periodontium and associated tooth structure:

The surrounding gingiva of a tooth is assessed by connective tissue extension and bony housing. Periodontal biotypes are categorized into^[6]:

- a) Thin scalloped periodontium
- b) Thick flat periodontium

Thin scalloped periodontium has a delicate soft tissue veil, the osseous form is scalloped and rudimentary, has a reduced quantity of

keratinised gingiva which results in dehiscence and fenestration of mucosa (Figure 6). The thick flat periodontium has a denser fibrotic soft tissue, the osseous form is thicker and has an elevated quantity of keratinised gingiva (Figure 7).

2.5. Bony anatomy of implant site:

The bony enclosure should have a 3-dimensional structure that allows for the implantation of a dental implant for long-term aesthetic reconstruction of anterior teeth.^[7] If the bony enclosure is not sufficient then bone augmentation procedures are done to enhance the site. A diagnostic wax up is done to recognize the inadequacy of hard and soft tissue (Figure 8).

Facio-lingual ridge anatomy is evaluated for adequate crest width implant placement. Reduced alveolar crest width requires bone grafting procedures to allow the placement of implant in the required position (Figure 9). Diagnostic techniques such as clinical sounding techniques (Figure 10) or CT scans (Figure 11) help in determining deficiencies in this dimension. The width of the facial bony wall and the alveolar crest height in the interproximal zones are two anatomical components that play a significant role in predicting the biotype of soft tissues after dental implant placement.

a) Height and extent of facial bony wall:

The prediction of gingival levels is assessed by the osseous crest position. During invasive procedure there is greater chances of tissue loss if the displacement of osseous crest to the free gingival margin is more. According to Kois, there is 3mm separation vertically of the dentogingival complex on the midface; a small apical tissue loss of 1 mm is anticipated following extraction and rapid implantation (Figure 12).^[8]

b) Crestal bone height in the interproximal area:

The interproximal crestal bone height plays a crucial function in the existence or non-existence of peri-implant papillae. Papilla gradually fills the space if there is 3-5mm contact point to the bone. In 45% of the time, the interdental papilla was non-existent, when the distance was 6 mm and in 75% of the time, when it was 7mm, the papilla failed to attain the space (Figure 13).^[4] Interdental papilla cannot be predictably conserved following surgery when the distance exceeds 5 mm (Figure 14).

2.6 Three-dimensional implant position:

Biological and restorative principles guide implant placement in aesthetic segment.

a) Apico coronal positioning:

Implant position should be 3-4mm beneath the free gingival margin (Figure 15). If implant is placed apically (>3-4mm) then the restoration will appear longer than the contralateral tooth. If placement of implant is too coronally (<3-4mm) there will be extensive loss of both hard tissue and soft tissue. The restoration will appear more shorter when compared to contralateral tooth.

b) Mesio distal positioning:

Prevention of damage to adjacent tooth and to anticipate acceptable contours, a minimum 1.5-2mm distance should be there between the dental implant and existing dentition (Figure 16).^[9]

c) Facio-lingual positioning:

Assessment of the crestal bone width and the atrophy of the facio lingual bone are to be considered prior to implant emplacement. If it is deficient then bone augmentation is necessary (Figure 17, 18 and 19).

Preservation of interproximal bone height can be achieved if there is more than 3mm separation between two adjoining implants. This results in 0.45mm loss of bone on

average, giving opportunity for the growth of interproximal papillary height. If the space between adjoining implants is less than 3mm, lateral bone resorption occurs from nearby implants (Figure 20).

To achieve the optimal aesthetic result, clinicians must consider an important dimension that is the timing of the treatment sequence.

The following categories apply to when teeth are extracted and implants are inserted.^[1]

- **Class 1:** Following extraction, osseous augmentation, GBR, a connective tissue graft, or an allograft, if necessary, are put in the extraction socket coupled with an immediate implant. Extraction followed by fast implant placement, "incisionless" implant implantation into the alveolar socket, or by raising the mucoperiosteal flap.

- **Class 2:** Early implant insertion. After extraction, the implant placement is done and the soft tissues must mend for 6 to 8 weeks. GBR is carried out during implant insertion or during tooth extraction.

- **Class 3:** Implant placement that is delayed. Implant placement is carried out 4-6 months following extraction while protecting the loss of alveolar ridge using grafting methods or GBR while doing extraction or concurrently implantation. In this situations, soft tissue repair is always necessary.

If the vertical distance between the peak of the interdental papilla to the contact point of a hopeless tooth to the extremity of the interproximal bone is less than or equal to 4.5mm then immediate implant can be placed and when more than 4.5mm then bone augmentation procedure is required and delayed implant is placed.

Association of bone Socket wall to immediate implant emplacement^[1]:

The preservation of the bony architecture is ensured by immediate dental implant placement into extraction sockets.

Immediately placed implants in extraction sockets will not avert the event of ridge resorption [Table no. 1].

3. Prosthetic options in implant dentistry:

FP1: Replaces anatomical crown of natural tooth. Minimal loss of hard and soft tissue.

FP2: Replaces anatomical crown and root portion of natural tooth. Minimal to moderate loss of hard tissue.

FP3: Replaces anatomical crown and portion of soft tissue. Moderate to advanced loss of hard and soft tissue.

4. Soft tissue assessment encircling single-tooth implant restoration: the pink aesthetic score (PES)^[14]

Single-tooth implant rehabilitation is valued by dental professionals more and more since it is considered cutting-edge (Tarnow & Eskow 1995) and humane (Newman 1999).^[10] To achieve the best cosmetic appearance, implants must be positioned and angled correctly (de Lange 1995; Phillips et al. 1998).^[11] A good implant supported rehabilitation must resemble the qualities of natural teeth, according to Belser et al (2004).^[12] The peri-implant soft tissue influences the length of crown as well as its colour and texture, which is critical for the realistic outlook of implant supported single tooth replacements (Chang et al. 1999).^[13]

Assessment criteria – PES^[14] :

There are seven variables to assess:

1. Mesial papilla
2. Distal papilla
3. Soft-tissue level

4. Soft-tissue morphology
5. Alveolar process
6. Soft-tissue colour
7. Soft-tissue texture.

Each variable is given a score from 0-1-2, with 2 denoting the best and 0 being the worst score (Figure 21) (Table 2).^[14]

We assessed the presence, absence, or completeness of the mesial and distal papilla. Comparing reference teeth, such as the similar tooth (anterior area) or a tooth that is close by (premolar region), allows one to assess the other characteristics.^[14]

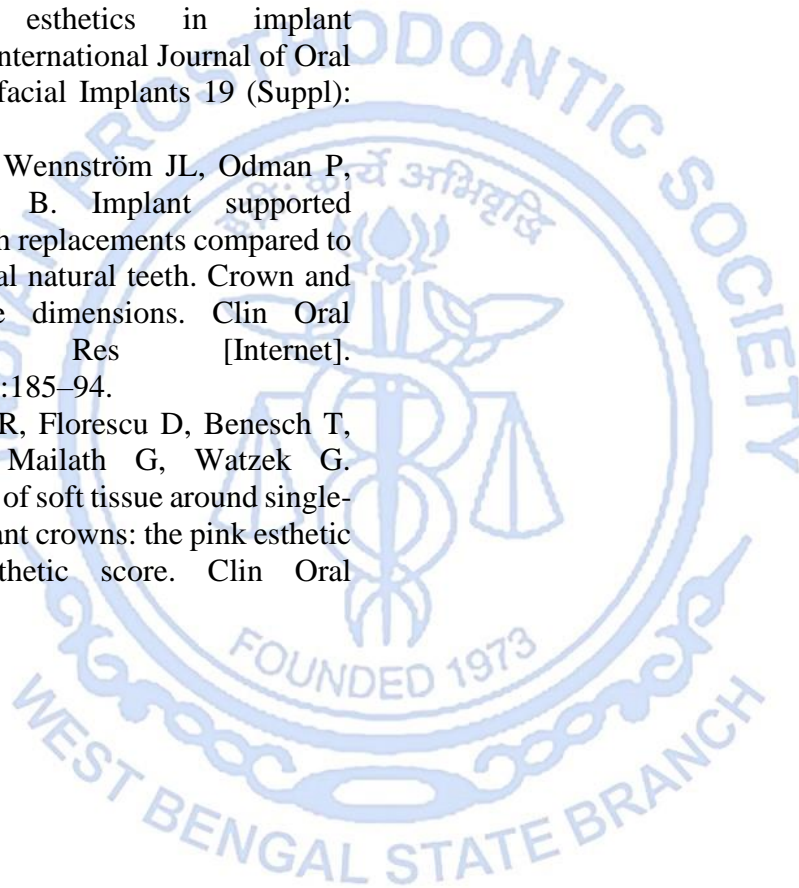
5. Conclusion

The clinician can develop an effective treatment strategy with the help of a correct understanding of the classification and indications for dental implant emplacement in the aesthetic zone. Timing is a crucial factor in the development of an aesthetically pleasing implant prosthesis and is used to place an implant in a 4D idea in 3 dimensions. The methods for surgical and prosthetic restoration with the dental implants are compiled in this review article. It can be difficult for a physician to restore a tooth in its exact location while simulating the previous anatomy and function; as a result, this review paper provides guidelines for achieving successful treatment planning for prosthesis supported by dental implant in the anterior aesthetic zone.

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TABLES

Class	Buccal bone	Implant emplacement technique	Expected outcome of immediate implant	Indication for immediate implant
Class 1	Intact with thick tissue biotype	Immediate without raising the flap	Optimal	Yes
Class 2	Intact with thin tissue biotype	Immediate with CTG or staged CTG	Good	Yes
Class 3	Insufficient but implant emplacement is acceptable in persisting alveolar bone of extraction socket	Simultaneous immediate with GBR and CTG or followed by staged CTG	Acceptable	Limited
Class 4	Insufficient and implant may deviate from alveolar bone	Delayed	Unacceptable	no

Table No. 1: Classification of Immediate implant emplacement.

Factors		0	1	2
Mesial papilla	Appearance w.r.t. reference tooth	Non existent	Partial	Adequate
Distal papilla	Appearance w.r.t. reference tooth	Non existent	Partial	Adequate
Level of soft tissue margin	Level w.r.t. reference tooth	>2mm	1-2mm	<1mm
Soft tissue contour	Natural, identical to reference tooth	Atypical	Fairly natural	Natural
Alveolar process	Alveolar process deficiency	Apparent	Slight	None
Soft tissue colour	Colour w.r.t. reference tooth	Apparent difference	Moderate difference	No difference
Soft tissue texture	Texture w.r.t. reference tooth	Apparent difference	Moderate difference	No difference

Table No. 2: Factors for the pink aesthetic score.

FIGURES



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7



Figure 8



Figure 9

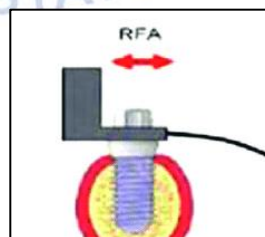


Figure 10



Figure 11



Figure 12

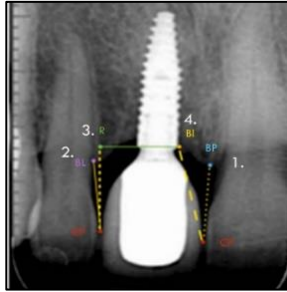


Figure 13

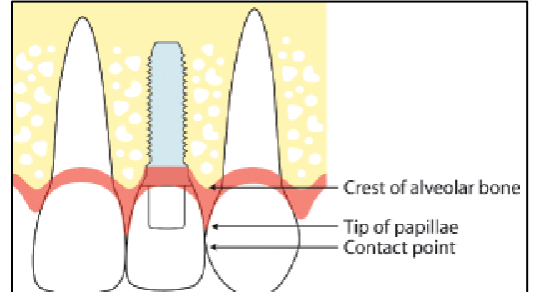


Figure 14

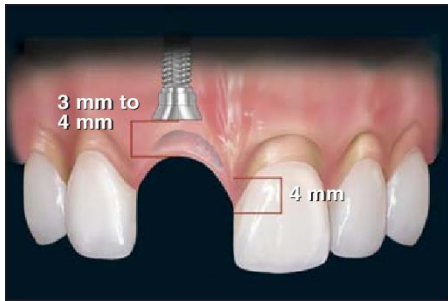


Figure 15

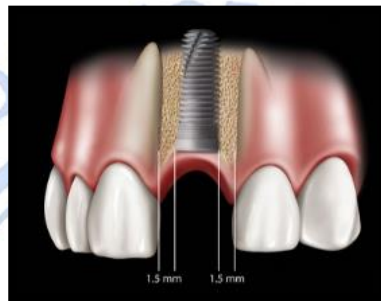


Figure 16



Figure 17



Figure 18



Figure 19

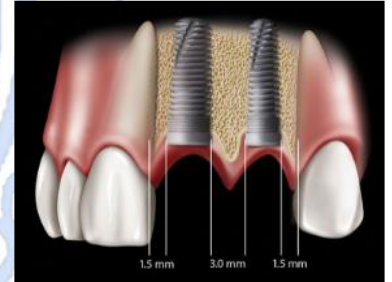


Figure 20



Figure 21