

Soft Tissue Consideration for Implants Placement in Esthetic Zone

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Abstract: Replacement of missing teeth with implants has made a revolutionary change in restorative dentistry. There is increasing demand for esthetics along with restoration of comfort and function. Adequate zone of attached tissue around a natural tooth or implant prosthesis is desirable to better withstand the functional stresses resulting from mastication, oral hygiene efforts and to maintain predictable levels over time. The importance of soft tissue in implant dentistry is often underestimated. The present literature review focuses various non-surgical and surgical procedures for soft tissue augmentation in implantology and also discusses various approaches to preserve and restore the interdental papilla. Goals for peri-implant soft-tissue grafting are to create a stable peri-implant soft tissue environment by providing an adequate zone of attached non-mobile tissues with intimate adaptation to emerging implant structure and reconstructing soft tissue architecture for maintaining harmonious relationship with implants. There are several factors that affect peri-implant soft-tissues which should be taken into consideration while planning for soft-tissue augmentation procedures around implants. So it is important for an implantologist to not only select the appropriate procedures for optimal soft tissue management but to also sequence them properly.

Keywords: Soft tissue augmentation, implants, peri-implant esthetics, surgical and nonsurgical approaches.

I. Introduction:

Replacement of single or multiple missing teeth with soft and hard tissue deficiencies in esthetic zone is most challenging part for implantologist. Branemark and coworkers in 1969 introduced the concept of replacement of missing teeth by implants and osseointegration. This made a revolutionary change in restorative dentistry. Patients increasing demand for esthetic as well as functionally sound prosthesis have given rise to special concern while placing implants in esthetic zone.

Belser and colleagues¹ in a literature review published in 2004 have mentioned that dental implants in the anterior maxilla have an overall survival and success rate similar to those reported for other segments of the jaw. **Eckert and Wollen** in 1998² conducted an 11-year retrospective study evaluating 1170 implants placed in partially edentulous patients and found no differences in survival rates of the implants with regard to their anatomical location. Placement of implant in esthetic zone is extremely technique sensitive. Hence, proper examination, diagnosis and treatment are essential. Preservation or regeneration of lost soft and hard tissue is extremely important for success of implant. Several surgical and non-surgical procedures have been proposed to preserve or regenerate soft tissue in peri-implant areas. This literature review includes proper diagnosis and management of soft tissue surrounding implants in esthetic zone.

II. Soft Tissue Management Prior To Implant Placement In Esthetic Zone:

Peri-implant plastic surgery focuses on harmonizing peri-implant structures by means of hard tissue engineering and soft tissue engineering, and includes: bone structure enhancement; soft tissue enhancement; precision in implant placement; and quality of the prosthetic restoration.³ Goals of soft tissue augmentation surrounding implants is to create adequate zone of attached non-mobile tissues with intimate adaptation to emerging implant structure and reconstructing soft tissue architecture

2.1 Implant-soft tissue attachment:

Clinically, peri-implant mucosa follows contour of alveolar bone. Alveolar height and width are very important factors determining soft tissue contours around but tooth morphology, location of the interdental contact point, and arrangement and quality of soft tissue fibers also influences soft tissue appearance around implants. In this article, only soft tissue consideration around implants in the esthetic zone has taken into consideration.

2.2 Factors affecting peri-implant soft tissue:

Myshin and Wiens in 2005⁴ have suggested various internal and external factors that influence peri implant soft tissue health. Internal factors are 1) Patient's general health and age, 2) The presence of keratinizing and attached, 3) Presence of adequate vestibular depth, 4) The periodontal condition of the remaining dentition External factors are 1) Use of tobacco, 2) Provision of adequate soft tissue rest during healing, 3) Maintenance of oral hygiene, 4) Preservation of biologic width and 5) Factors related to implant placement

Histologically, **Schupbach and Glauser in 2007⁵** have demonstrated remarkable similarities between peri implant and periodontal soft tissues. Implant also demonstrates formation of 1) oral epithelium 2) sulcular epithelium and 3) junctional epithelium surrounding it. Oral epithelium which is keratinized provides mechanical protection, sulcular epithelium provides cellular immunological protection and junctional epithelium provides protective permucosal seal against infection. But the connective tissue attachment surrounding implant is relatively acellular and avascular. Circumferential and alveolar crestal connective tissue fibers are absent.

Implant placement in esthetic zone precedes detailed patient evaluation and history, diagnosis, treatment planning before preparation of the implant placement in esthetic zone. Proper inquiry about medical history of the patient is necessary for determining presence of uncontrolled diabetes, hypertension or any medications that may lead to complications before, during or after implant surgery.

Evaluation of facial and dental symmetry, upper lip line, lower lip line, incisal plane, occlusal plane, tooth proportions and relationships, gingival plane and gingival outline, periodontal biotype, marginal tissue recession and alveolar ridge defects before placing an implant in esthetic zone. Any asymmetries in any of these should be treated with combined orthodontic, restorative and periodontic approaches.

Smile line, lip position and lip mobility: Davis A. in 2003⁶ stated that the tone and the shape of the Vermilion, the Vermilion tubercle and the philtrum are significantly influenced by the maxillary bone anatomy, the position of implants, the periimplant anatomy and the dental morphology. Maxillary anterior teeth should touch inner dry and wet junction of lower lip. If teeth touch outer or inner surface of lower lip than it may be considered inappropriate.

Occlusion and occlusal forces: Hsu M. et al in 2007⁷ stated that the direction, intensity and duration of masticatory forces on implants are greatly associated bone density and thickness. Nonaxial implant forces may cause bone stress and subsequent bone loss. Proper occlusal adjustment or prosthodontic may be needed to direct the masticatory forces as much as possible towards the long axis and ensure of an implant.

Tooth proportions and relationships: For proportions of a maxillary central incisor, an intrinsic width to length ratio of 75-80% is considered esthetically pleasing which is appropriate in relation to patient's face. This proportion is known as **golden proportion** which can be used as a guideline for establishing tooth to tooth proportions. Harmonious relation is when central incisor appears nearly 60% wider than lateral incisor and lateral incisor appears to be nearly 60% wider than mesial aspect of canine. **Morley⁸** gave **50-40-30 rule** suggesting ideal connector zones optimal smile esthetics for central incisor, lateral incisor and mesial aspect of canine.



Fig 1: Golden Proportions of Teeth

Chiche and pinault⁹ identified two morphologies for gingival outline sinous and straight. In sinous type of morphology gingival margin of central incisor and canine are at higher level as compared to lateral incisor while in straight type of morphology gingival margins of all three teeth are at same level. Exaggerated sinous pattern or extreme apical location of gingival margin of lateral incisor to that of central incisor and canine has an unesthetic appeal. **Gingival plane and gingival outline:** Gingival Zenith is very important aspect in determining gingival plane and outline. **Gingival Zenith** is most apical part aspect of gingival margin



Fig 2: Gingival outline

Periodontal Biotype: Ochsenbein C et al in 1973¹⁰ described a correlation between tooth morphology and periodontal biotype. Biotype I: The triangular shaped tooth is linked to a thin, scalloped periodontium. Biotype II: the interproximal contact area is located in the coronal one-third of the crown and is associated with a long, thin papilla. The square-shaped tooth is connected to a thick, flat periodontium. Thick blunted biotype resist gingival recession by scar formation and thin scalloped biotype reacts to surgical or restorative insults by gingival recession, apical migration of attachment and loss of alveolar bone.

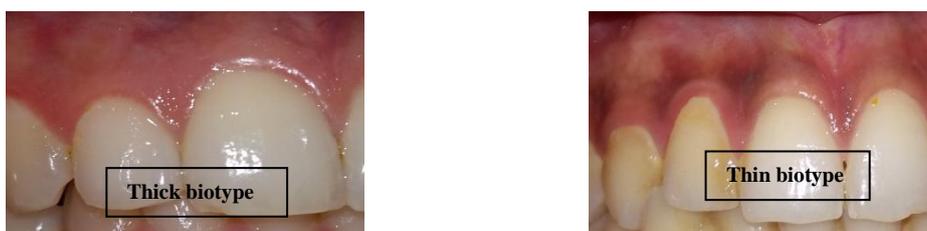


Fig 3: Periodontal Biotype

Classification used for gingival recession around implants is same as that of normal gingiva.

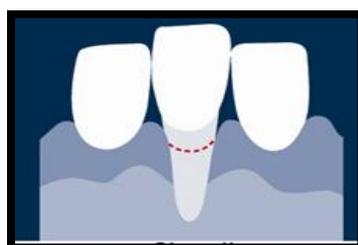
Classifications of gingival recession used in implants are:

1. Sullivan and Atkins classification in 1968¹¹: Shallow narrow, shallow wide, deep narrow and deep wide
2. Miller's classification in 1985¹²:

Class I: Marginal tissue recession not extending to the Mucogingival Junction (MGJ). No loss of interdental bone or soft tissue.



Class II: Marginal recession extending to or beyond the MGJ. No loss of interdental bone or soft tissue.



Class III: Marginal tissue recession extends to or beyond the MGJ. Loss of interdental bone or soft tissue is apical to the CEJ, but coronal to the apical extent of the marginal tissue recession



Class IV: Marginal tissue recession extends to or beyond the MGJ. Loss of interdental bone extends to a level apical to the extent of the marginal tissue recession



Classification of alveolar ridge defects: The **Palacci-Ericsson classification in 1996**¹³ system divides implant sites into four classes according to the vertical and horizontal dimensions of tissue loss, respectively. This system classifies alveolar ridge defects based on loss of papilla.

Vertical loss Class I, intact or slightly reduced papillae; class II, limited loss of papillae (less than 50%); class III, severe loss of papillae; and class IV, absence of papillae (edentulous ridge).

Horizontal loss Class A, intact or slightly reduced buccal tissues; class B, limited loss of buccal tissues; class C, severe loss of buccal tissues; and class D, extreme loss of buccal tissue, often in combination with a limited amount of attached mucosa.

The periodontist cannot expect to go directly from class IV to class II or from class III to class I in one surgical procedure. However, a class IV case may convert to a class II case in a series of treatment procedures.

VERTICAL LOSS	HORIZONTAL LOSS
Class I	Class A
Class II	Class B
Class III	Class C
Class IV	Class D

Table1: Combinations of various defects

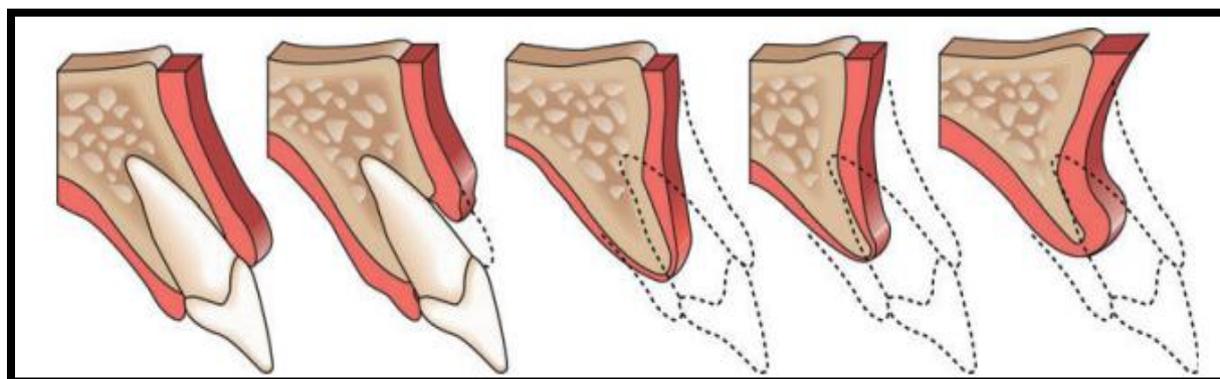


Fig 4: Palacci-Ericsson classification¹³

Periodontal plastic surgery along with ridge augmentation procedure permits soft tissue preservation and management in areas critical to the achievement of successful esthetics. In addition, minor surgical procedures such as gingivoplasty can create gingival contours that more closely resemble the previously existing condition of the periodontium.

III. Surgical Techniques For Preservation And Regeneration Of Soft-Tissues:

There are various surgical techniques used for the soft tissue management around implants since their inception. The surgical techniques here are arranged based on treatment planning which follows - site preservation, flap techniques, soft tissue grafting, Guided tissue regeneration and implant placement.

3.1. Site Preservation

The Bio-Col technique: Boyne in 2001¹⁴ showed when there existed combination of hard and soft tissue defect Bio-Col technique was used for site preservation. Immediately after extraction of tooth the site was preserved using osteoconductive material like Bio-Oss for bone regeneration and absorbable collagen dressing known as collaplug was condensed in to socket. The socket was sealed using impervious cement. Provisional restoration was given over it to prevent tissue collapse.

3.2. Minimal Invasive Flap Techniques For Implant Surgery

Papilla preservation flaps: Sclar in 2003¹⁵ suggested that when mesial and distal papilla are present, they should be left intact by giving beveled peri-crestal incision joining facial vertical incision. If papilla is depressed it will be included in either buccal or lingual/palatal flap.

Curvilinear incision: Miller PD Jr in 1988¹⁶ advocated use of curvilinear incision in place of linear incisions especially where larger amount of hard or soft tissue graft needs to be covered. It includes larger volume of mucosa and improves elasticity of flap.

U-peninsula flap: Miller PD Jr in 1988¹⁶ suggested that buccal incisions should be avoided where unnecessary in patients with thick periodontium. Buccal incision in such cases will lead to gingival scarring and ultimately causing gingival recession. Palatal or lingual U-peninsula flaps are advocated in such cases.

3.3. Soft Tissue Grafting Around Implants

Sub epithelial connective tissue graft: Langer and calagna in 1982¹⁷ suggested that a connective tissue graft obtained from maxillary tuberosity area can be harvested in facial area with deficit interdental papilla for its reconstruction.

Epithelialized palatal mucosal graft or Free Gingival Graft (FGG): Atkins and Sullivan in 1968¹⁸ proposed a technique by which split thickness palatal mucosal graft is obtained and harvested over prepared recipient bed. Graft is immobilized by sutures and absorbable collagen dressing is laced over it.

SCTG and FGG can be combined with Coronally Advanced Flap (CAF) for treating implant dehiscence.

Modified palatal roll technique: Scharf and Tarnow in 1992¹⁹ advocated that rotating or rolling of palatal connective tissue pedicle to labial side for treating small volume soft tissue defect around maxillary implants in anterior region. This is indicated for labial and vertical soft tissue augmentation.

Vascularized Interpositional Periosteal Connective Tissue Flap (VIP-CT Flap): Anthony Sclar in 2003²⁰ described a procedure by which sub epithelial palatal connective tissue periosteal pedicle flap is raised in premolar/molar area and rotated into the prepared anterior recipient site. It is positioned beneath curvilinear flap on recipient bed and sutured. VIP-CT has number of advantages over other flaps that includes intact vascularity, minimal patient discomfort and graft shrinkage.

Papilla regeneration: Jemt T in 1997²¹ advocated a second stage surgery to fill up interdental space between implant and adjacent teeth. T-shaped incision is advocated than lateral sliding of these flaps is advocated filling up the space between implant and abutment/adjacent teeth.

Zarb G. in 1986²² described that rough implant surface and more number of threads increase surface area of implants and hence, provide excellent success rate for implants.

3.4. Guided Tissue Regeneration

Guided Tissue Regeneration (GTR): The concept of using GTR membranes for soft tissue augmentation was introduced by **Melcher in 1976²³**. GTR membranes are of great importance immediate trans-mucosal implant placement. A titanium plasma-sprayed implant is installed at the bottom or in the wall of the extraction socket. An expanded polytetrafluoroethylene barrier membrane (Gore-Tex) is tightly adapted around the implant over the bony margins of the alveolus. The flaps are then replaced, adapted around the neck of the implant and sutured. It is proposed that placement of GTR membrane, a barrier between the gingival tissues and the gap stops apical migration of epithelium and gingival connective tissue from migrating into the wound space, allowing periodontal and bone regeneration. Membranes used for Guided tissue regeneration includes expanded polytetrafluoroethylene, polyglactin, polylactic acid, calcium sulfate, and collagen.

Thoma D. et al in 2014²⁴ conducted a systematic review to determine efficacy of soft tissue augmentation procedures around dental implants and in partially edentulous sites. In the systematic review 20 articles were included which studied augmentation of keratinized mucosa (KM) and soft tissue volume around implants and in partially edentulous areas. An apically positioned flap/vestibuloplasty (APF/V) plus a graft material [free

gingival graft (FGG)/subepithelial connective tissue graft (SCTG)/collagen matrix (CM)] resulted in an increase of keratinized tissue in the range of 1.4-3.3 mm. Statistically better outcomes were obtained for APF/V plus FGG/SCTG compared with controls (APF/V alone; no treatment) ($p < 0.05$). An APF/V plus FGG/SCTG was the best-documented and most successful method to increase the width of KM. Autogenous grafts (SCTG) rendered an increase in soft tissue thickness and better aesthetics compared to non-grafted sites. Thus, it can be said till day SCTG remains gold standard for soft tissue augmentation around implants.

IV. Non-Surgical Techniques For Soft Tissue Management:

- 4.1 Maintenance of appropriate oral hygiene and use of chemical and mechanical plaque control aids may prevent apical migration of soft-tissue. **Shapiro in 1985**²⁵ suggested repeated scaling, root planing and curettage every 15 days for first three months and than once every 6 months will maintain healthy state of interdental papilla. But results for this depend on patient's effort for oral hygiene maintenance. Hence, results for this are unpredictable.
- 4.2 **Norland and Tarnow in 1992**²⁶ determined the effect of distance from contact point to crest of bone on presence or absence of interdental papilla. Tarnow also suggested that lengthening of contact area can eliminate interdental black triangles.
- 4.3 **Anthony Sclar in 2003**²⁷ suggested use of provisional restoration for supports and guides soft tissue healing at implant site.
- 4.4 **Kamalkidhis in 2007**²⁸ suggested use of gingival colored porcelains which mask interdental papilla and have excellent esthetic results.

V. Conclusion:

As famous saying goes 'Beauty is power; a smile is its sword'. Importance of good smile in enhancement of overall personality of a person cannot be neglected. Hence, Esthetics holds a very important position even in implant dentistry. When replacement of missing anterior teeth is done with implants, esthetics is a prime concern along with function. Hence, it is very important for an implantologist to examine patient properly, select appropriate augmentation procedures and also sequence them in a timely order before, during and after implant placement.

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