Periodontal considerations in implant therapy

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Purpose: This paper is aimed to address periodontal considerations around dental implants. Tools used to identify disease/infection and techniques developed to correct peri-implant infection were thoroughly discussed. Procedures that have been successful used in maintaining/correcting soft/hard tissue problems around dental implants were explored.

Materials and Methods: Critical appraisal of the current techniques regarding the soft/hard tissue grafts is performed. Techniques that have shown predictable outcomes were selected and discussed. Guidelines for treating peri-implant infection and dealing with different soft/hard tissue defects were provided.

Results: Peri-implant infection can be early identified and treated. Ridge preservation as well as guided bone regeneration prior to implant placement had been widely adopted as the predictable treatment methods. Soft tissue grafting such as connective tissue graft, ovate pontic site development, and other common soft tissue grafts (e.g., roll, pouch, interpositional grafts, onlay grafts and combination grafts) can be successfully applied in augmenting peri-implant tissue height and width while achieving esthetics around dental implants. In addition, implant maintenance care is necessary for the overall success.

Conclusion: To maintain implant long-term success, the interface between soft and hard tissues should be clearly understood. Several procedures such as ridge preservation and guided bone regeneration have shown promising results in restoring/maintaining the alveolar bone height and width to facilitate ideal implant placement. Many soft tissue grafts, for example connective tissue graft, have been used to augment soft tissue thickness while provide esthetic results around dental implants.

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Clinical Significance: This paper provides ways of maintaining/correcting soft/hard tissue defects around dental implants.

Key Words: dental implant, guided bone regeneration, implant maintenance, implant plastic surgery, peri-implant mucosa, soft tissue graft.

Introduction

Dental implants have been shown to successfully replace missing teeth while provide all restorative functional needs. Techniques and materials have been developed over the years to facilitate a high degree of clinical success. Nonetheless, the ultimate long-term success of implants is largely relied upon the interface between implants and their surrounding tissues, both soft and hard tissues. Dental implants have two distinct interfaces with oral tissues. First, the soft tissue-implant interface is where the peri-implant mucosa meets the implant creating a biological seal to prevent future disease invasion. Due to the natural of the tissue components, soft tissues surrounding the dental implants are called peri-implant mucosa instead of gingiva. And second, the hard tissue-implant interface is where the alveolar bone contact with implant surface. This integration provides stability and rigidity that implant needs. To achieve and maintain long-term success of dental implants, it is necessary to understand how these interfaces are and how they can be maintained. Therefore, the aims of this paper are to discuss these interfaces and to recommend ways of promoting/maintaining these implant biological structures.

Implant/Soft Tissue Interface

Epithelial Attachment

The peri-implant mucosa, similar to the natural gingival, can be divided into two parts: epithelium and connective tissue. Table 1 summarizes the differences between implants and natural teeth. Briefly, the epithelial tissues around implants move more in apico-coronal direction and as a result it is average 1 mm longer when compared to natural teeth.[1-3] The attachment of epithelial cells to implant surface occurred directly via basal lamina (<200 nm) and hemidesmosomes which was the same as natural teeth.[4-7]

The implant surface topography has been shown to play a role in influencing how soft tissue attached to dental implant. It is generally agreed that polished surfaces are more compatible to fibroblasts than rough surfaces.[8-12] Obtaining a peri-implant mucosal seal to prevent bacterial invasion is suggested as a pre-requirement for maintaining long-term success of dental implants.[13,14] When the seal is not achieved, it often leads to apical migration of the epithelium, thus cause partially or completely encapsulation of the endosseous implant.[15,16] In natural teeth, the junctional epithelium provides a seal at the base of the sulcus against the penetration of chemical irritants and bacterial by-products. Once disruption of the seal and/or destruction of the fibers apical to the epithelium take place, the epithelium migrates apically, forming a periodontal pocket. Due to the lack of cementum and fiber insertion into the implant surface, the biologic seal was important in preventing formation of a "peri-implant pocket" extending into the osseous structures.

Connective Tissue Attachment

The average length of connective tissue attachment around implant ranges from 1.3 to 1.8 mm.[2,17] Majority of the studies showed a parallel-oriented fiber’s orientation instead of perpendicular as those formed in natural teeth.[18] In addition, the connective tissue around implants had been shown to possess less vascularities, more collagen and less fibroblasts when compared to natural teeth. The connective tissue of the peri-implant mucosa can be further divided into outer and inner zone. The outer zone located under the junctional epithelium, is composed of collagen Types I and III and is responsible for the transformation of collagen. The inner supracrestal connective tissue zone is composed mainly of Type I collagen and is responsible for mechanical resistance and stability of the peri-implant mucosa.[18,19] The origins of the blood supplies around implants are terminal branches of large vessels originating from the periosteum and they differ from that around natural teeth that come from supra-periosteal vessels and the vessels of the periodontal ligament.

Table 1. Differences between implants and natural teeth.

	Natural teeth	Dental implants
Connection	Cementum, PDL, Bone	Osseointegration, Functional ankylosis
Junctional epithelium	Basal lamina and hemidesmosome	Basal lamina and hemidesmosome
Connective tissue (fiber orientation)	Perpendicular	Parallel
Vascularity	More	Less
Collagen	More (85%)	Less (65%)
Fibroblasts	Less (1-3%)	More (5-10%)[130]
Biological width	JE+CT (Fig. 1)	SD+JE+CT
	1.91 mm[131] 2.04 mm[132]	3.09 mm[2] 3.80 mm[130]

JE: Junctional epithelium, CT: Connective tissue, SD: Sulcus depth.

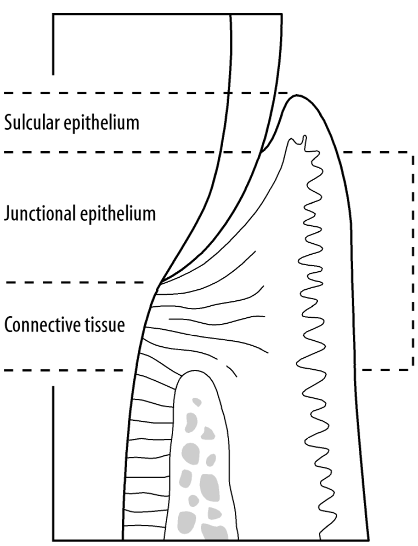


Fig. 1. Biological width in natural teeth.

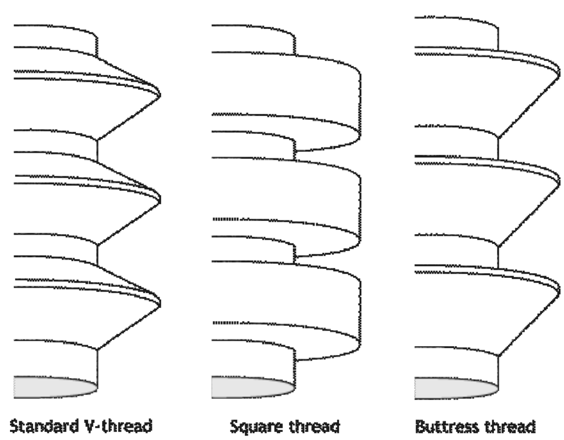


Fig. 2. Implant thread designs.

Biological Width

The biological width around dental implants acts as a protective barrier against potential bacterial infection, food debris entrapment into the implant/soft tissue interface. It had been shown in animal and human studies that an adequate biological width/seal can only be achieved if there is a supra-crestal smooth titanium surface of at least 3 mm long in the apico-coronal direction.[2,15,20-23] Approximately 2 mm of the surface was occupied by the junctional epithelium, while the rest 1mm is connective tissue.

Biological width has been reported composed of 2.0 mm of junctional epithelium and 1.3 to 1.8 mm connective tissue for a two-part implant.[17] Similar dimensions were also observed around one-part implant before and after 12 months loading.[2] Recent evidence has suggested that reformation of biological width may be the primary etiology contributing to early implant crestal bone loss.[24] Nevertheless, some authors have speculated that biological width/seal increases approximately 1 mm after implant loading, possibly due to crestal bone resorption.[25]

Keratinized Mucosa to Maintain Implant Health

The need of keratinized mucosa around dental implants to maintain implant mucosa health remains controversial, since healthy peri-implant tissues can be observed regardless of the amount of keratinized mucosa.[26] It has been reported 90% of overall fixture survival rate even only 67% of these cases had keratinized mucosa in the facial aspect and 51% in the lingual surfaces.[3,26] Hence, it had been challenged that keratinized mucosa is not the pre-requisite for peri-implant health and movable tissue surrounding dental implant does not contribute to more implant failure.[27,28] On the other hand, some papers have reported increased implant failure rate in the areas of insufficient peri-implant mucosa width.[29] Although the conflicted results existed, it is desirable to have keratinized mucosa around the implant since keratinized tissue not only promotes resistance to mechanical trauma but also facilitates personal home care and professional maintenance procedure.[30,31] Different procedures including connective tissue grafts, free gingival grafts, and others have been described to augment keratinized mucosa around dental implants successfully.[32,33]

Implant/Hard Tissue Interface

Successful implant therapy is based on osseointegration, which has been characterized as "a direct structural and functional connection between ordered living bone and the surface of a load-bearing implant".[34] Most long-term clinical trials have demonstrated the success of cylindrical, screw-type, smooth surface titanium implants.

Osseointegration and long-term stability of implant depends on the early interactions between the implant surface and various cell populations. The early events of optimal bone healing around implant sites are: protein adsorption, cellular adherence, local factor production, proliferation, matrix production, and calcification. Ideally, dental implants should have surfaces that result in precise control over these types of tissue activities.

Implant Macrostructure

Thread-designed dental implants have been shown to possess higher surface contact areas, more mechanical retention to maximize initial contact and improve initial stability, and better force distribution when compared to cylinder-type implants.[35,36] The greater the number and the deeper depth of threads, the more functional surfaces are available. Three thread shapes: square, V-shape, and buttress have been used in implant dentistry (Fig. 2). The face angle of the thread changes the direction of load from the prosthesis to a different force direction at the bone. Under axial loading to an implant, a V-threaded face is comparable to the buttress thread when the face is similar, usually is 30 degree.[37] It had been demonstrated to have 10 times greater shear loads on bone compared with a square thread.[37] A square thread had been proposed to reduce the shear force by transferring a more axial load along the implant body to compress the bone. A buttress thread is optimized for pull-out loads.[38] Although the differences in force transfer to bone was suggested in different thread design, no controlled clinical studies comparing the three designs are available.

Implant Microstructure

To improve the clinical success of dental implants, modification of implant surfaces microstructures has been attempted. Roughened implant surfaces often showed higher adhesive strength than smooth surfaces. This is supported by most of animal and human biopsy studies where bone-to-implant contact (BIC) and resistance to shear forces by removal-torque values were used to show the differences.[39-45] However, controversial remains with regard to the BIC and its clinical relevance. In a study comparing BIC in six different implant surfaces, HA-coated and sandblasted/acid-etched surfaces showed the highest BIC.[46] Similar results were also reported in other studies.[39,40,47]

Implant Infections and Their Management

Microbiology and occlusal overload are two most common etiologies for implant failure. Nonetheless, bacterial plaque is often regarded as the primary responsible reason for implant failure after loading.[48,49] The imbalance between host and parasite causes a series of inflammatory changes, thus leads to two distinct clinical syndromes; 1) Mucositis is a reversible inflammatory lesion confined to the superficial peri-implant mucosal tissues. Generally, the prevalence is around 28% after 2 year implant loading.[50] 2) Peri-implantitis is a lesion involving the marginal portion of the bone-implant interface besides the peri-implant soft tissues. Five to 10% of overall prevalence has been reported.[50]

Peri-implant mucositis has the similar clinical characteristics as those of in gingivitis, similar relationship was also noted between peri-implantitis and periodontitis.[51] Therefore, it has been suggested that conventional periodontal therapy should be instituted if inflammation develops around implants, as those happened to natural dentition.[52,53] The ailing implants had been defined as problems limited to the peri-implant mucosa and not involving the supporting bone, more recently, as biological complications.[48,54]

Peri-implant probing depth, mucosal recession, bleeding upon probing, and peri-implant exudation have all been suggested as useful diagnostic tools for detecting biological complications.[55-57] The emergence profile of the final restoration influences the accuracy of peri-implant probing depth, since assessing probing depth around overcontoured crowns is largely irrelevant unless the superstructure is removed to allow parallel probing to the long axis of implant fixture. In addition, the presence or absence of inflammation influences the outcome of probing, since probe often penetrates deeper (e.g. close to alveolar bone) in presence of mild to moderate mucositis.[58] Stable implants usually present approximately 3 mm of probing depth, while diseased implants had deeper penetration of the probe. The deeper implant probing depth resulted in a shift of microflora (e.g., to more gram negative anaerobics) to induce more disease invasion.[2,57]

The microbiological findings related to healthy and failing implants are similar as those in healthy and periodontally compromised teeth.[55,57] Increased levels of subgingival *Porphyromonas gingivalis, Prevotella intermedia,* and *Fusobacterium nucleatum* may lead failure of dental implants. However, failing implants with a traumatic etiology may have a microflora predominant in streptococci which is consistent with periodontal health.[59] The microbiota present in the remaining dentition may serve as a reservoir for bacterial colonization around implants.[60,61] Therefore, it is often recommended to control patient's overall periodontal problems before initiate complex implant therapy. Increased levels of PGE_2, IL-1ß, and PDGF were also formed in failing implant sites which indicated that not only the microbiota but also the host response is similar to those of periodontally diseased teeth.[62]

Table 2. Implant infections and their proposed treatments.[133]

Ailing implant	
Definition: Soft tissue inflammation without bone loss	
Proposed treatment	
Non-surgical treatment: Mechanical debridement, Antibiotic: systemically or locally	
Failing implant	
Definition: Inflammation with bone loss but without mobility	
Proposed treatment	
Vertical defect:	<2 mm: GBR; Osteoplasty-convert to horizontal defect
	>2 mm but <1/2 Implant height: GBR; Autogenous bone wedge grafting
	>1/2 Implant height: Implant removal
Horizontal defect:	<1/2 Implant height: APF; Osteoplasty; GBR
	>1/2 Implant height: Implant removal
Failed implant	
Definition: Inflammation with bone loss and with mobility	
Proposed treatment: Implant removal	

APF: Apically positioned flap, GBR: Guided bone regeneration.

The clinical features of peri-implantitis include: radiographic evidence of vertical destruction of the crestal bone, not dependant on implants mobility, formation of a peri-implant pocket in association with radiographic bone loss, bleeding after gentle probing, suppuration might also be present, mucosal swelling and redness, pain is not a typical feature of peri-implantitis.[51] Peri-implantitis can lead to ailing implant, failing implant and failed implant. Treatments of ailing and failing implant remain a challenge to many clinicians. Once infected, implant surface is contaminated with endotoxin, it must be detoxified before any regenerative therapy can be performed. The goals of non-surgical and surgical therapies are to re-establish healthy peri-implant soft and hard tissues. Table 2 listed current available diagnostic criteria for implant failures as well as their proposed treatment. Occlusal therapy is indicated if occlusal overload is one of etiologic factors for peri-implant bone loss. Antiseptic non-surgical therapy (e.g. antibiotics) is suggested by some authors for treating deep pockets more than 5 mm.[63,64] Surgical procedures such as regenerative approaches have been tried and shown promising outcomes after surface is being detoxified. Air powder abrasions as well as acid (e.g. citric or tetracycline) had been shown to be effective in detoxifying contaminated implant surfaces.[65,66]

Esthetic Management Around Dental Implants

Success of implant therapy not only depends on fixture osseointegration and restoration of function, but also esthetic requirements which arise in recent years. The procedures available for esthetic regenerations are not as predictable as implant placement procedure. However, esthetic plastic surgical techniques for correction of various soft tissue defects including recession, mucogingival defects, and improper gingival contours have been considered routine procedures during implant therapy.

In attempting to achieve optimal esthetic results after implant therapy, following requirements are essential: adequate bone volume (discussed in previous section), optimal implant position and angulation, stable and healthy peri-implant soft tissues (discussed in previous section), proper soft tissue contours, and ideal emergence profile.[67] After verifying the tissue and ridge defects, modification of the soft tissues can be performed prior to implant placement, at stage I and II surgery, or after implant placement.

Pre-placement Soft Tissue Modification

Soft tissue modification prior to implant placement to provide proper tissue contour and support can increase the predictability of the treatment outcome, however additional surgical procedure is necessary to achieve the goal (Tables 3 and 4). Ridge preservation procedure using bone graft, barrier membrane in extraction socket had been shown to be predictable.[68-70] Although longitudinal data was still lacking for evaluating the net effect from ridge preservation procedure, it is still preferred by many clinicians.[68,69] Atraumatic removal of the tooth with preserving most of the bone architecture is the key to successful ridge preservation. Modified techniques for ridge retention were also been described including: Bio-col technique, modified graft preservation, and spontaneous in-situ gingival augmentation.

Table 3. Techniques for soft tissue modification.

Ridge preservation
Bone grafts plus barrier membranes (e.g., Bio-Col technique)
Combinations of soft and hard tissue graft
Ovate pontic site development (Spontaneous in situ gingival augmentation)
Nature healing of extraction socket (minimal 6 months of healing)
Orthodontic forced eruption
Slow eruption (less than 1 mm/month)
Controlled tissue expansion
Expand soft tissue by placing silicon balloon expander first. After space is obtained then bone grafts will be placed with primary wound coverage to ensure better healing.
Common soft tissue grafting procedures
Roll technique, Pouch procedure, Interpositional graft, Onlay graft, Combination grafts

Utilization of orthodontics in erupting hopeless teeth to augment bone and soft tissue support prior to extraction had been demonstrated successfully in proposed implant site.[71-73] Increased treatment time and cost are the drawbacks.[74,75] The controlled tissue expansion was to expand soft tissue by placing silicon balloon expander to expand existing soft tissue in ridge deficiency to enhance primary coverage of subsequent osseous graft.[76] However, additional soft tissue grafting to gain keratinized tissue is often required. Soft tissue grafting procedures such as roll technique, pouch technique, interpositional grafts, onlay grafts and combination grafts can be successfully applied in augmenting peri-implant tissue height and width.

Table 4. HVC ridge deficiency classification and therapy.[89]

Classification		Therapy
Horizontal (H)	S	Roll, Pouch, Inlay CT graft
	M	Pouch, Inlay CT graft
	L	Inlay CT graft, Interpositional graft
Vertical (V)	S	Interpositional graft
	M	Interpositional graft, Onlay graft
	L	Interpositional graft, (Onlay graft)
Combination (C)	S	Combination of ST grafts
	M	Combination of ST grafts
	L	Not applicable

CT: Connective tissue, ST: Subepithelial connective tissue.

Stage I and II Soft Tissue Modification

The previously discussed soft tissue modification techniques can be performed at the time of implant placement or abutment connection. Soft tissue augmentation performed at abutment connection eliminated additional surgical procedure. In the non-esthetic areas, apically positioned flap to increase keratinized tissue can be employed at stage II surgery. The underlying bony support and contours can be evaluated for the need of augmentation procedure.

The presence/absence of interdental papilla had been described and classified.[77,78] The vertical distance between the contact point and crest of bone was significant in determining the presence of papilla between implants and adjacent teeth.[79] When the distance was ≤ 5 mm, the papilla was present almost 100% of the time. However, when the measurement was ≥ 6 mm, the papilla was only present $\leq 50\%$ of the time. It was further speculated that remaining bone crest influenced on the presence or absence of papillae either in implants or teeth. This should be taken into consideration when performing esthetic implant surgeries. In addition, when the distance between two implants is <3 mm, it often resulted in more horizontal bone loss thus caused in loss of inter-implant papilla.[80] The techniques such as papilla regeneration technique,[81] coronally repositioned flap, soft tissue graft, gingival recontrouring,[82,83] guided soft tissue augmentation[84] have been developed to correct deficient papillae contours at stage one/two surgery.

Post-placement Soft Tissue Modification

As previously described in the GBR section, it is mainly composed of hard tissue regeneration or hard and/or soft tissue resective procedure to restore the health of the peri-implant tissue.

Ridge Deficiency and Its Management

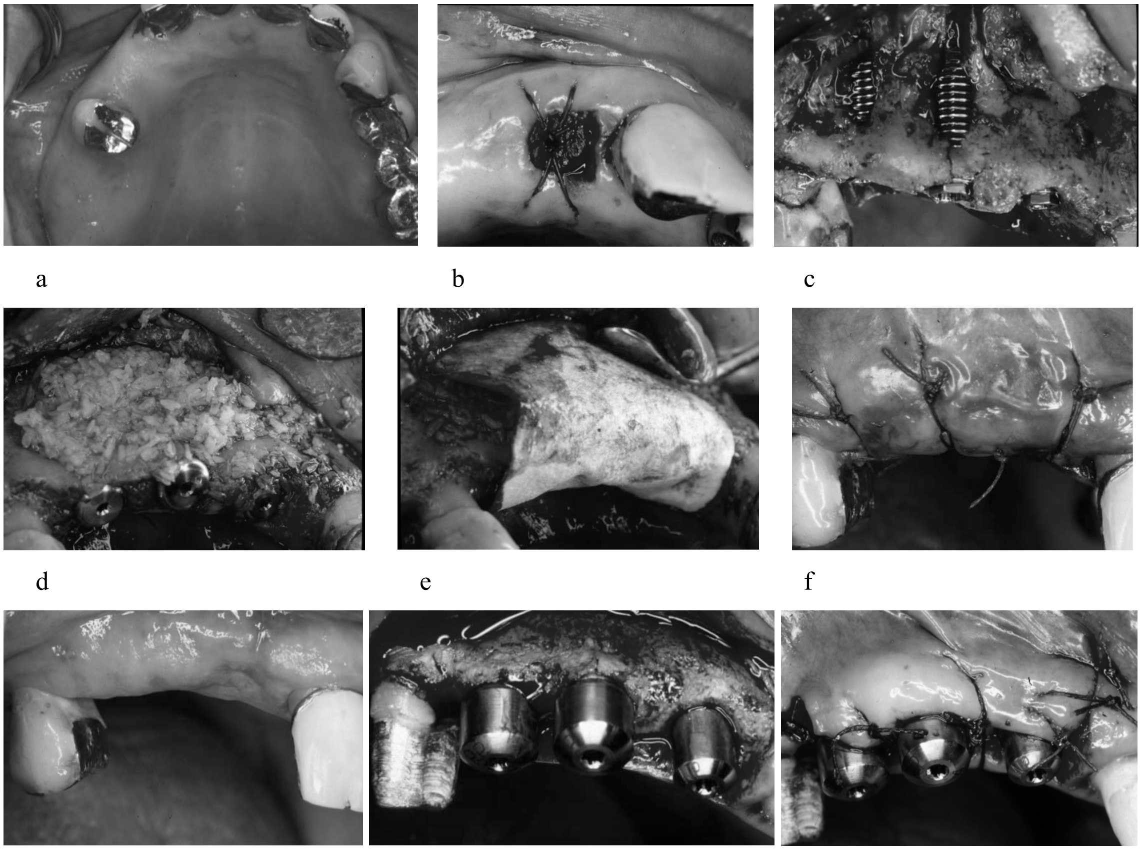
Adequate bone volume pre-requisites the implant therapy and proper esthetic result. Inadequate alveolar bone height and width often requires bone augmentation procedures either performed prior to, at the time of, or after the implant surgery.

Ridge Deficiency

Alveolar ridge defects resulting from tooth extraction, trauma or periodontal disease are recommended to have surgical corrections prior to their comprehensive prosthodontic reconstruction, especially implant prosthesis. Without careful consideration and proper treatment planing, hard and/or soft tissue defects may lead to functional, structural or esthetic compromised in the final prosthesis. Several classification systems of alveolar ridge deformities have been proposed.[85-88] We recently published a therapeutically oriented HVC ridge deficiency classification.[89] Table 4 lists the proposed classification as well as its suggested treatment.

The techniques that had been described for ridge augmentation include guided bone regeneration, block graft, particulate graft, ridge expansion technique, and distraction osteogenesis.[90-94] Extra-oral cortico-cancellous bone grafts for ridge augmentation was primarily used for the reconstruction of atrophic arches.[95-98] However, extra-oral graft sources have the disadvantages of great morbidity and expense. Therefore, the use of intra-oral graft sites have been suggested for ridge augmentation procedures in smaller defects.[99-103] Intra-oral sources of block grafts include the symphysis, body, and ramus of mandible. Decreased morbidity, convenient surgical access, lack of cutaneous scar formation, and favorable bone quality are the advantages of intra-oral graft sources. The application of distraction osteogenesis in alveolar ridge augmentation prior to implant placement had been evaluated and provided promising outcomes. However, long-term evaluations and refinements in methodology are needed for establishing this technique in ridge augmentation.

The principle of guided bone regeneration (GBR) was first examined in animal studies.[104,105] It had been demonstrated that GBR improves new bone formation by excluding fibrous tissue migration into the defects with absorbable or non-absorbable membranes.[104-106] Utilization of GBR technique to regenerate deficient ridge to allow implant placement and to correct osseous defects around implants had been evaluated.[107,108] GBR with cell-occlusive barrier membranes used for horizontal or vertical ridge augmentation with or without bone grafts showed varying degrees of success.[70,90,104,109,110] When proper surgical techniques are used and principles are followed, GBR procedures provide a fairly predictable outcome (Fig. 3). Regenerated bone has been shown to respond like non-regenerated bone in bearing/sustaining implant functional load.[111]



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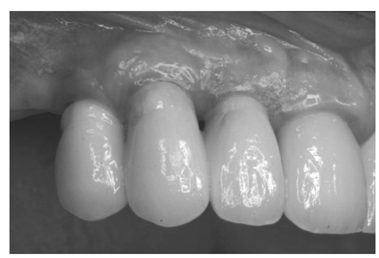

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Fig. 3. Biologic width in natural teeth and dental implants.

a Pre-treatment maxillary occlusal view.

b Ridge preservation (demineralized free-dried bone allograft plus collagen plug with cross mattress suture) was performed right after tooth extraction.

c Implants were placed and fenestration wound was noted in all three implants.

d Autograft and demineralized free-dried bone allograft were placed to act as space creater and maintainer.

e Collagen membrane (BioMend, Centerpulse Inc., Carlsbad, CA) was placed around the defect.

f Flap was sutured with three vertical modified mattress sutures.

g One month healing.

h Implant un-covery surgery showed newly regenerated bone around fenestration defects.

i Apically positioned flap was used to augment soft tissue thickness.

j Final results.

The benefit of GBR for correcting dehisced alveolar ridge was investigated for the use of GBR in threads exposed implants in deficient ridges.[112-116] Both absorbable and non-absorbable membranes were evaluated and reported to be successful in treating dehiscence defects.[112-116] Bone grafting materials were combined in treating dehiscence defects with GBR and had shown successful regenerative results.[115,116]

An alternative to ridge augmentation procedure is to use expansion techniques to increase the width of the existing ridge. Several techniques had been proposed including osteotome, ridge expansion, and the piezoelectric scalpel expansion technique.[90,117-122] The aim of these expansion techniques is to reduce surgical morbidity and complications associated with grafting procedures while providing similar success rates.[117,121]

At the time of abutment connection, the stage two procedure, GBR or hard and/or soft tissue resective procedures need to be considered if implant related defects was discovered. The guidelines for treating vertical and horizontal alveolar defects were listed in Table 2.

Implant Maintenance

Implant maintenance can be divided into professional maintenance and personal home care. The essential aspect of any maintenance program is patient compliance, which is dependent upon:[123] the relative simplicity of the procedure; the time required; minimum number of devices.

Oral hygiene instructions should be performed and modified according to each patient's condition. The devices such as regular toothbrush, some types of floss (G-floss, Oral-B Superfloss), yarn, or tape have been shown capable of cleaning the interproximal implant areas. Interproximal brushes can also be used in some areas, however it should be plastic-coated to avoid any metal damage or contaminate to the titanium implant surface.[123] The important message is to use whatever patient felt comfortable so they can use them regularly and effectively. Different mouthrinses such as 0.12% chlorhexidine or Listerine have been suggested as adjuncts to aid in the personal oral hygiene in maintaining implant health. No clinical or microbiological effects could be demonstrated in these studies.[124,125] One week after abutment placement, the patient should be recalled for evaluation and oral hygiene instructions.

Implant is like a tooth, regular professional cleaning is needed in order to maintain its long-term stability. Professional cleaning will facilitate: removal of existing plaque, prevent early plaque attachment, inhibit future plaque accumulation/formation as well as to avoid bacterial pathogen shift. Three months prophylaxis is often recommended as those observed in the natural dentition.[126] Due to the natural of titanium implant surface, it is often recommended not to use metallic instruments since it may scratch the implant surface as well as causing metal corrosion.[127] Metal ultrasonic scalers severely disrupt the titanium dioxide surface, create the multitude of grooves and roughened surfaces. This often leads to further plaque retention, and therefore may compromise longevity success of dental implants. However, when an ultrasonic scaler covered with a plastic tip, the titanium surface was uncharged and plaque can be effectively removed from the implant surfaces.[128] Various forms of plastic scalers have been advocated for removing calculus deposits from the surfaces of abutments, but these have not been particularly effective.[128] Gold-plated Gracey curettes do not affect the titanium surface examined by scanning electron microscopy and hence it was recommended by some authors for clinical usage.[123] Gold-alloy-tipped scaler, plastic scaler, graphite-reinforced scaler, air powder-abrasive system, and rubber cup with tin oxide slurry have all been suggested to clean the implant surface. Among these, air abrasive system has been shown to be the most effective method in removing plaque from implant surfaces.[129] Rubber-cup polishing with a very fine abrasive paste is another method for deplaquing of implant surfaces in the dental office.[123]

Conclusion

Dental implants have been successfully used in the treatment of partially or fully edentulous patients. To facilitate ideal implant placement, procedures attempted to restore/maintain the alveolar bone height and width have been developed and have shown promising results. Ridge preservation as well as guided bone regeneration prior to implant placement had been widely adopted as the predictable treatment methods. Soft tissue grafting to enhance esthetic outcomes had also been addressed in many recent literatures. Techniques such as connective tissue graft, ovate pontic site development, and other common soft tissue grafts (e.g., roll, pouch, interpositional grafts, onlay grafts and combination grafts) can be successfully applied in augmenting peri-implant tissue height and width.

To maintain implant long-term success, the interface between soft and hard tissues should be clearly understood. When the implants are infected, surface should be detoxified and treatment should be provided accordingly. In addition, implant maintenance care is necessary for the overall success. It affords clinicians an opportunity, over time, to continuously diagnose, modify treatment, re-evaluate potential pathogenic disease or identify disease recurrence. With professional maintenance care and effective home care habits, post-treatment peri-implant health can be maintained for an undetermined period of time.

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