

## Management of Ailing & Failing Implants: A Review

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**Abstract:** A dental implant is a surgical component that interfaces with the bone of the jaw or skull to support a dental prosthesis such as a crown, bridge, denture, facial prosthesis or to act as an orthodontic anchor. Success or failure of implants depends on the health of the person receiving it, drugs which impact the chances of osseointegration and the health of the tissues in the mouth. In addition to undisturbed osseointegration and an adequate prosthetic design, implant maintenance is crucial for long term prognosis. Various factors are responsible for implant failure. These factors may influence failure directly or indirectly. Improper patient selection, accumulation of bacterial plaque because of poor oral hygiene, traumatic occlusion, debris retention resulting from improper prosthetic restoration, and bone preparation without the sufficient cooling, low torque, slow-speed hand pieces, have been the factors contributing to the failure of dental implants. The aim of this article is to highlight the reasons of dental implants failure, their classification, prevention, management and recent advances in dental implant care and to eliminate peri-implant infections and inflammation.

**Keywords:** Dental implants, Failures, Ailing and failing implants, Preventive regimes, Management.

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### I. Introduction

Missing teeth can cause loss of self-esteem and have an impact on social interaction. The diminished masticatory efficiency accompanying tooth loss can compromise nutritional status, putting one at higher risk for chronic illnesses like diabetes, cancer, hypertension and cardiac disease. Conventional dentures typically attain only limited success with respect to both client satisfaction and chewing ability. An implant-retained prosthesis provides greater stability, improved biting and chewing forces and higher client satisfaction than a conventional denture. Dental implants also may be used to replace teeth in a client who is partially edentulous. Osseo integration provides support for function, while dental implants are used as replacements for natural teeth<sup>1</sup>.

Osseo integration is defined as the direct connection between live bone and a functioning endosseous implant, the term "functioning" implying that the contact between live bone and the surface of the implant is sustained while active or load-bearing. Technological advances have allowed for the increased acceptance and use of dental implants in a variety of restorative treatments. The oral rehabilitation of partially or totally edentulous patients with dental implants has become a common practice over the last decade, with reliable long term results. The documented high survival rate of osseointegrated root form dental implants has led to their acceptance as a realistic treatment alternative. In spite of these successes, however, over a 5 year period, 0 to 14.4% of the dental implants demonstrated peri-implant inflammatory reactions which were associated with crestal bone loss that may eventually lead to the loss of an implant. It has been shown that the inflammation is more pronounced and the inflammatory process goes deeper and faster around the dental implant than around the adjacent natural tooth. It has been suggested that implants have a less effective natural tissue barrier than natural teeth and are less resistant to infection<sup>2</sup>.

The predictability of a stable soft tissue attachment has not been confirmed, and the per mucosal seal may be just a circular fibre arrangement around the implant. Peri-implantitis is defined as an inflammatory process which affects the tissues around an osseointegrated implant in function, resulting in the loss of the supporting bone, which is often associated with bleeding, suppuration, increased probing depth, mobility and radiographical bone loss<sup>3</sup>. Its pathogenesis is characterized by either the traditional pathway (from the soft tissues apically to the bone), or retrograde (from the bone to the soft tissues). Reported predictors for implant success and failure are generally divided into patient-related factors which include general patient health status, smoking habits, quantity and quality of bone, oral hygiene maintenance and implant characteristics such as dimensions, coating, loading, implant location and clinician experience. The management of implant failure can be performed through two different interventions: surgical or non surgical approaches. Bacterial infections and

inflammation of periimplant tissue induce bone loss and jeopardize clinical success. Various treatment modalities including mechanical debridement, antibiotics and antiseptics, laser treatment have been advocated. Lasers are an integral part of dental office out patient care and lasers have a definite part to play in maintenance of implants and management of periimplantitis. Treatment of the contaminated implant surface by mechanical and chemotherapeutic means has met with mixed success. Incomplete surface debridement or alteration of the implant surface could compromise attempts at grafting and reintegration of the implant body. Development of a laser system operating at 2780 nm and using an ablative hydrokinetic process offers the possibility for more efficient decontamination and debridement<sup>4</sup>.

The Er, Cr: YSGG laser is evaluated and compared with the most commonly used chemotherapeutic modality for treatment of the implant surface. A scanning electron microscope study is presented comparing YSGG ablation to citric acid treatment of the titanium plasma sprayed and HA coated implant surface and concluded that laser ablation using the YSGG laser is highly efficient at removing potential contaminants on the roughened implant surface while demonstrating no effects on the titanium substrate<sup>5</sup>.

## **II. Causes Of Implant Failure**

**Failed Osseointegration:** - Osseointegration describes the formation of a direct functional and structural connection between a patient bone and an artificial implant. This process takes place over the course of several months after the implant is placed. Failure of an implant is often attributed to the failure of the jawbone to fuse together properly with the implant. An implant is deemed a failure if it is mobile falls out or shows signs of bone loss of more than 1 mm after the first year and more than 0.2 mm after the second year. Several factors can cause this to happen including incorrect positioning, insufficient bone density or volume, overloading, damage to surrounding tissues, external force & sudden impact, fractured implants or even a reaction to anesthesia. Before an implant can integrate properly into a jawbone, there must be a healthy volume and density of bone present<sup>6</sup>.

**Overloading** In certain cases, the implantologist may decide to perform immediate loading during a dental implant procedure. Immediate loading is a one-stage treatment method where the crown and abutment are placed on the dental implant right after the post is surgically inserted. The normal process consists of two stages and provides time for the implant to integrate with the bone before adding the components that protrude above the gingiva.

Advantages of this method include less post-surgical care, quicker recovery and shorter treatment times. However, this all-in-one procedure can lead to complications since implant integration is incomplete. Overloading is the term given to failures caused by undue pressure or forces placed on the protruding abutment and/or crown. These forces can easily disrupt the osseointegration process. Patients who have inadequate bone mass may not be eligible for immediate loading<sup>7</sup>.

**Sinus Problems** Replacing teeth in the maxillary arch with dental implants sinuses can be a major challenge. In addition to the presence of the sinuses, insufficient bone quality and quantity in the maxillary arch jaw can make dental implant procedures in this area difficult. To develop a strong bone foundation; an oral surgeon may perform a sinus augmentation. This procedure involves lifting the existing bone into the sinus cavity to create enough space that for a bone graft<sup>8</sup>. The goal is to create & add space and bone mass in that area in order to overcome of short comings like lack of bone height, width or length & provide support to place dental implant. However, if the implant protrudes into the sinus cavity, the area can become infected and/or inflamed. An X-ray or CT scan can easily detect this problem and corrective surgery can then be performed. Patients should inform their oral surgeon of sinus issues prior to the implant procedure. The density of bone beneath missing teeth deteriorates over time since it is not being stimulated by the forces of chewing. Patients who have been missing teeth for months or years often require bone grafts before they can get implants<sup>9</sup>.

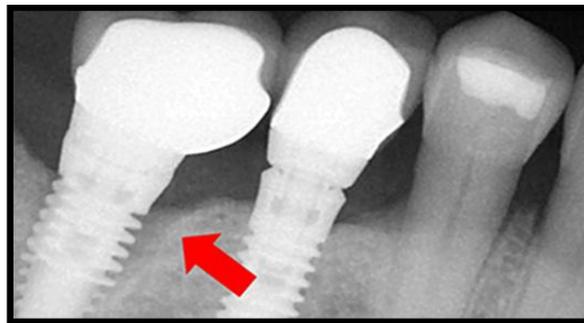
**Other Risks & Causes of Failure** The following are other risks and causes of dental implant challenges for patients to consider.

**Foreign body rejection.** In the case where the patient's body see the dental implant as a foreign object that does not belong and pushes it out.

**Failure of the implant itself** – Even though they are made of metal (usually titanium); it is possible for the post to bend or even break. The incidence has decreased over years because of advancements in implant design and materials, but it is still possible. An implant can crack or fracture if it is subjected to excessive external forces. This could be a sudden impact like a blow to the face or excessive pressure over a period of time like grinding teeth or an unbalanced crown<sup>10</sup>.

**Allergic reaction** – Most implants today are made of a titanium alloy that contains traces of nickel. While quite rare, some patients can have an allergic or inflammatory reaction to titanium. The symptoms can range from itchiness to Chronic Fatigue Syndrome. The MELISA test is the only scientifically-proven way to determine titanium allergy and what the severity is.

**Loosened Dental Implant Associated with Pain** Clinically, loosening of a dental implant is characterized by increased mobility with or without pain. Radiographically, the loss of peri-implant crestal bone is associated with loose implants. Loosening of a dental implant soon after placement is primarily due to surgical trauma, overheating of the osteotomy, complicated wound healing, insufficient primary stability and/or initial overload. Intermediate or late loosening of a dental implant more commonly results from marginal peri- implant mucositis and/or biomechanical overload, influenced largely by host characteristics. Loose dental implants could also be the result of surgical trauma due to overheating of the osteotomy or non ideal implant position resulting in nonaxial forces during occlusion, improper crown design, high occlusal alignment or improper size selection of the implant and abutment. Loose dental implants can also result from implant surface characteristics and/or designs. Individuals with poor oral hygiene, parafunctional habits, bruxism and high occlusal loading. Patients at risk for loosened dental implants include heavy smokers; individuals with poorly controlled diabetes, osteoporosis, or osteomalacia; individuals taking certain medications; and those who have previously undergone irradiation of the implant site. Peri-implant mucositis affects the gingiva and is usually reversible. If untreated, this may progress to marginal peri-implantitis that manifests as progressive bone loss around the implant and may result in implant mobility if untreated <sup>11</sup>.



**Figure 1. Radiolucency around the cervical portion (arrow) of the implant associated with clinical mobility and gingival inflammation. Courtesy: J Can Dent Assoc 2014; 80:e46**

**Peri-implantitis** is a site specific infectious disease that causes an inflammatory process in soft tissues, and bone loss around an osseointegrated implant in function. It has been shown that the inflammation is more pronounced and the inflammatory process goes deeper and faster around the dental implant than around the adjacent natural tooth. It has been suggested that implants have a less effective natural tissue barrier than natural teeth and are less resistant to infection. The predictability of a stable soft tissue attachment has not been confirmed, and the per mucosal seal may be just a circular fiber arrangement around the implant. Implant failure has classically been attributed to bacterial infections, occlusal overload, surgical trauma, faulty or incorrect prosthetic design and/or improper surgical placement. The management of implant infection should be focused both on the infection control of the lesion, the detoxification of the implant surface and regeneration procedures <sup>12</sup>.

**Aetiology** Bacterial infections play the most important role in the failure of dental implants. Bacterial flora which are associated with periodontitis and peri-implantitis, are found to be similar. Studies have shown that the bacterial flora at the failing implant sites consist of gram-negative anaerobic bacteria including porphyromonas gingivalis, prevotella intermedia and actinobacillus actinomycetemcomitans which resemble the pathogens in periodontal disease. It has been demonstrated that the bacteria which are found in the implant sulcus in the successful implant cases, are basically the same flora as are found in the natural tooth sulcus in a state of health. The implants in partially edentulous patients appear to be at a greater risk of peri-implantitis than the implants in completely or fully edentulous patients. There are few qualitative differences in the microflora surrounding implants and the teeth in partially edentulous patients. However, there is a marked quantitative decrease in the number of periodontal pathogens around the implants in completely edentulous patients <sup>13</sup>.

It is possible that the natural teeth may serve as reservoirs for periodontal pathogens from which they may colonize the implants in the same mouth. This reinforces the importance of rigorous oral hygiene programs in the implant patients. Biomechanical factors such as an occlusal overload may play a significant role in the failure of the implant. The occlusal overload may result in progressive bone loss around the implant, thus leading to the failure of the implant. The implants which suffer from traumatic failure have subgingival

microflora resembling that which is present in a state of periodontal health, with cocci and nonmotile rods as the predominant morphotypes i.e. streptococcus and actinomyces species as the predominant microflora. The other aetiological factors are patient related factors that include systemic diseases e.g. diabetes mellitus, osteoporosis, etc; social factors- such as inadequate oral hygiene, smoking and drug abuse; para functional habits e.g. bruxism and iatrogenic factors such as lack of primary stability and premature loading during the healing period <sup>14</sup>.

**Diagnosis** A number of clinical parameters which are used to evaluate periodontal conditions have also been used to assess the peri-implant conditions. Swelling, redness of the peri-implant marginal tissues, calculus build up and bleeding on probing are important signs of peri-implantitis. Suppuration is a clear indicator of the disease activity and indicates the need for anti-infective therapy.

Probing the peri-implant sulcus with a blunt, straight plastic periodontal probe such as the automated probe allows the assessment of the peri-implant probing depth, bleeding on probing and exudation and suppuration from the peri-implant space. Studies have shown that successful implants generally allow a probe penetration of approximately 3 mm to 4mm in the healthy peri-implant sulcus. Periapical intra oral radiographs reveal the peri-implant bone status as well as the marginal bone level. Progressive bone loss is a definite indicator of peri-implantitis, but it should not be confused with physiological bone remodelling around the implant during the first year of function <sup>15</sup>. The implant mobility serves to diagnose the final stage of osseous disintegration. For the interpretation of low degrees of mobility, an electronic device like periostest has been used. Bacterial cultures, DNA probes, polymerase chain reaction (PCR), monoclonal antibody and enzyme assays which are used to monitor the subgingival microflora can help to determine an elevated risk for peri-implantitis. It is a biologically sound and good medical practice to base the systemic antimicrobial therapy on appropriate microbiological data<sup>16</sup>.

**Management** If clinical and radiological evidences suggest that the peri-implant conditions are not stable and that advancing bone loss is occurring, this indicates the need for intervention. Peri-implantitis is managed by using specific treatment strategies, depending on the aetiology of the problem. When biochemical forces are considered as the main aetiological factors; then the first phase involves an analysis of the fit of the prosthesis, the number and position of the implants, and an occlusal evaluation <sup>17</sup>. Occlusal equilibration; improvement of the implant number and position, and changes in the prosthetic design can contribute to arrest the progression of the peri-implant tissue breakdown.

The second phase includes a surgical technique to eliminate the deep peri-implant soft tissue pockets or to regenerate the bone around the implant. When the main aetiological factor is bacterial infection; the first phase involves the control of the acute infection and the reduction of inflammation. This involves the local removal of the plaque deposits with plastic instruments and the polishing of all the accessible surfaces with pumice, the subgingival irrigation of all peri-implant pockets with 0.12% chlorhexidine; systemic antimicrobial therapy for 10 consecutive days; and improved patient compliance with oral hygiene until a healthy peri-implant site is established. This may be sufficient to re-establish gingival health or may need to be followed by a surgical approach in the second phase <sup>18</sup>.

**Non-Surgical Therapy** The most conservative approach to treatment involves non-surgical therapy. This treatment modality includes three subcategories:

- a) Pharmacological therapy.
- b) Occlusal therapy.
- c) Mechanical debridement.

Pharmacological therapy for patients presenting with an ailing implant involves sub gingival irrigation for 10 days to 3 weeks for 2 to 3 times in a day. This may be completed at home following careful instructions from the clinician or dental hygienist. Chlorhexidine is most often prescribed because of its antimicrobial effect and substantivity at the affected site. Other pharmacological therapies include local application of tetracycline fibers and systemic antibiotics. Bacteria associated with failing implants have been found to be sensitive to the following antibiotics: penicillin G, amoxicillin, combination of amoxicillin and metronidazole, and amoxicillin-clavulanate<sup>19</sup>.

**Oral Antimicrobial therapy for peri-implantitis <sup>20</sup>**

Antimicrobial	Adult Dosage
Clindamycin <sup>†</sup>	300 mg, then 150-300 mg q8h
Amoxicillin/clavulanate	875 mg q12h
Metronidazole <sup>†</sup> plus 1 of the following:	500 mg, then 250 mg q6h or 500 mg q12h
Penicillin VK	250-500 mg q6h

or Amoxicillin	1000 mg, then 500 mg q12h
or Erythromycin <sup>†</sup>	250 mg q6h
or Azithromycin <sup>†</sup>	500 mg x 1d, then 250 or 500 mg q24h x 4d
or Clarithromycin <sup>†</sup>	250-500 mg q12h or 1 g PO q24h

Occlusal interferences may contribute to ailing and failing implants. Occlusal adjustment is necessary when premature contacts or interferences are present. The implant prosthesis also must be examined when grinding, bruxing, or other parafunctional habits are evident. The clinician must correct these occlusal errors to prevent overloading of the implant. Nightguard therapy may be indicated as well<sup>18</sup>. A third non-surgical therapy recommended for treating the ailing or failing implant is mechanical debridement. Local debridement of tissues surrounding an implant using either plastic hand instruments or ultrasonic instruments with a plastic tip has been suggested. Plastic instruments are necessary to debride plaque from titanium dental implants without damaging the soft titanium surface. The implants which are affected with peri-implantitis are contaminated with soft tissue cells, microorganisms and microbial by products. The defect must be debrided and the contaminated implant surface has to be treated to achieve the regeneration of new bone and for 're-osseointegration' to occur<sup>15</sup>.

Prophy jet, the use of a high pressure air powder abrasive (mixture of sodium bicarbonate and sterile water), has been advocated, as this removes the microbial deposits, does not alter the surface topography and has no adverse effect on cell adhesion. Various chemotherapeutic agents like contact with a supersaturated solution of citric acid (40% concentration; pH 1), chlorhexidine gluconate, stannous fluoride, and tetracycline are antimicrobials and/or antibiotics, for 30-60 seconds have been used for the preparation of the implant surfaces, as they have the highest potential for the removal of endotoxins from both the hydroxyapatite and the titanium implant surfaces. The type of implant surface will determine the method of decontamination to be applied. They also determine that machined titanium surfaces are the easiest to decontaminate and that topical tetracyclines (the content of one 250-mg capsule mixed with saline serum until a creamy consistency is obtained) are the antibiotic of choice in these cases<sup>14</sup>. Furthermore, it appears that tetracycline stimulates fibroblast growth in the affected area. Prolonged application times of citric acid solution are not recommended for use on HA surfaces, since this would alter the quality and impair its ability to bond to the titanium body of the implant. Once the application time has transpired, the treated surface must be abundantly irrigated. If the HA is already damaged due to the virulence of the infection surrounding the implant, the recommended approach is to eliminate it completely by drilling and then proceed to apply air abrasion or ultrasound and subsequently decontaminate the area with tetracycline in the same fashion as if it were a machined titanium surface<sup>7</sup>. Soft laser irradiation has also been used for the elimination of the bacteria which are associated with peri-implantitis. Additionally, the systemic administration of antibiotics that specifically target gram-negative anaerobic organisms has shown an alteration in the microbial composition and a sustained clinical improvement over a 1-year period.

Alternatively, a local delivery device, Actisite (fibers containing polymeric tetracycline HCl) has been tried and this resulted in significantly lower total anaerobic counts. The type of osseous defects should be identified before deciding on the surgical treatment modality. Therefore it is recommended to remove the implant prosthesis 4 to 8 weeks prior to the regenerative surgical procedure to allow compliance with the oral hygiene procedures and the soft tissue to collapse and heal over the implant site with a cover screw in place. Thus at the time of regenerative surgery a mid crestal incision can be made over intact tissue and full thickness flap is raised. If removal of prosthesis is not possible before hand then a sulcularis incision is made to raise the flap<sup>5</sup>.

**Surgical therapy** The first step in surgical therapy is to reflect the tissue and degranulate the defect. It is followed by exposing and treating the bacterially contaminated implant surface. The clinician must remove endotoxins from the surface of the failing implant. This is especially true of hydroxyapatite (HA) coated surfaces. The HA coating may be pitted, cracked, and brownish in color and may show areas of resorption down to the base metallic substrate. These surface changes result from the infectious aspects of disease and inflammation. As the pH in the area becomes lower during inflammation, the HA surface begins to decalcify and/or resorb. This resorption process is similar to the effects of periodontal disease, as the implant exhibits the subsequent loss of connective tissue attachment and establishes an osseous defect. It is important in an infected implant with HA surface that is deteriorating that the coating be removed by using an ultrasonic scaler as the use of hand currettes is slow and the air abrasives are associated with the danger of air emboli in marrow spaces.

The literature suggests using chemical agents to detoxify the surface of the failing implant<sup>21</sup>. The rationale for their use is the sub gingival flora associated with dental implants has been shown to be very similar to those associated with natural teeth. Chemotherapeutic agents such as which theoretically would not only kill the periodontopathic bacteria but also would remove endotoxins from a root implant surface. Once the implant is decontaminated, the next step is to regenerate or obliterate the osseous defect with a grafting material. Graft with freeze dried bone if completely detoxified or graft with an alloplast if not completely detoxified. The decision to utilize an alloplast or an allograft depends on the effectiveness of the detoxification of the implant surface. If the surface is clean and detoxified, with all exposed areas of the implant visualized and instrumented, it is possible to graft with an allograft material such as DFDBA to achieve biologic healing<sup>6</sup>. However, if the implant surface cannot be cleaned and detoxified due to vents, holes in the implant fixture, or tortuous osseous defects not accessible to instrumentation it is advisable to graft with an alloplast material such as HA or Bioactive Glass. Alloplasts provide a physical, biocompatible fill, minimize /probing depth, support the mucoperiosteal flap, and help prevent further epithelial invagination. In conjunction with the various grafts discussed for bone regeneration around failing implants, clinicians also may use membranes to keep these grafts in the desired location. Resorbable membranes are most commonly used today. Non-resorbable membranes are less commonly used because of the requirement for an additional surgery to recover the intact membrane<sup>4</sup>. It is important that the membrane extends 3-4 mm beyond the surgical defect and secured. The flap should be closed in primary closure with mattress and interrupted sutures without tension. Leave the implant out of function and covered for 10-12 weeks. After the healing is complete the abutment can be reattached after a stage 2 type surgery. In case there is no active infection present and the bone loss is due to overload the treatment procedure remains same except the HA coating of the implant should not be removed but the detoxification should be done only for 30 seconds as it tends to remove the coating.

Also tetracycline should not be used on intact HA as it changes the calcium phosphate ratio and will affect the healing dynamics. In case of one stage implants being treated or when the prosthesis has to be maintained a Perigingival Regenerative Therapy is done. The membrane is perforated with a 3 mm hole and slid over the implant. The membrane should ensure complete coverage and isolation of the vertical bone defect. The flap is then sutured closely to the implant neck. It is very vital to remove the membrane 6-8 weeks after surgery<sup>11</sup>.

This is necessary as there is no primary closure there is accumulation of plaque on the membrane and there is potential risk of infection of the membrane and the peri-implant site. If the defect is in the unaesthetic zone and is mainly of the horizontal type, the management can focus on the correction of the soft tissue portion of the peri-implant pocket. Standard techniques such as gingivectomy and apically displaced flaps are used in these situations to reduce the pocket and to improve the access for oral hygiene. If the vertical (< 3mm) one to two walled defects are found, then the respective surgery can be used to reduce the pockets, to smoothen the rough implant surfaces, to correct the osseous architecture and to increase the area of the keratinized gingiva. To arrest the progression of the disease and to achieve a maintainable site for the patient, all implant surfaces that are smooth and clean coronal to the bone level are preferred. Therefore, the surface with threads or roughened topography such as hydroxyapatites, are indicated for alteration with high speed diamond burs and polishers to produce a smooth continuous surface<sup>13</sup>. Surface modifications are not performed during a regeneration surgery, where metal particles can interfere with the regeneration of bones. Various bone graft techniques and guided bone regeneration (GBR); even in conjunction with platelet rich plasma (PRP), have been successfully used for the regeneration of lost bones in three wall or circumferential defects.

It is advisable to remove the prosthesis at the time of regenerative surgery; nevertheless, perigingival regenerative therapy for one stage implants or for implants with non-retrievable prosthesis can also be done. A thorough preparation of the implant surface should be followed by an elaborate rinsing with saline solution. Roughening of the bone surface can be done by penetration with round burs to increase the accessibility to the osteogenic cells. The membranes which are placed should ensure the complete coverage and the isolation of the bony defect. The reflected flap should be closed primarily over the site with a mattress and interrupted sutures. The membrane should be left undisturbed for 4-6 weeks. The long term success of any peri-implant treatment strategy requires a program of periodic maintenance, including subgingival plaque removal and instructions in proper hygiene<sup>18</sup>.

**Implant surfaces** have gone through an evolutionary change, from machined titanium to macro porous geometry. The first endosseous implants had a relatively smooth texture that was created through the machining process. This machined titanium surface allowed direct bone apposition while the relative smoothness of this surface helped to prevent bacterial colonization. With good periodontal care, even those implants with saucerisation defects were easily maintained by scaling and chemotherapeutic modalities. The second-generation implant surface was a titanium plasma sprayed (TPS) coating. Research indicated that a roughened

surface increased wettability and enhanced bone growth along the surface of the implant resulting in direct apposition of bone to titanium<sup>5</sup>.

This surface, although enhancing implant stability in bone, created an environment for increased plaque and bacterial colonization often resulting in osseous and soft tissue dehiscence. Early attempts at treatment consisted of apically repositioning flaps and removing the roughened surface. This could result in poor implant/crown ratios and resultant failure from biomechanical overloading. A third-generation implant surface consisted of blasting the implant body with an abrasive and then acid etching to remove the abrasive contaminant. This etching procedure resulted in a more defined ratio of peaks and valleys to increase wettability even further. However, this increased definition on the implant surface creates a more ideal surface for bacterial colonization and compromises our ability to maintain the implant when the body of the implant is contaminated or exposed<sup>12</sup>. One current generation of implant surfaces uses a sintering technique to create 3-dimensional in growth of bone so that shorter implants can be used. However, this surface becomes the most problematic when it becomes infected because normal maintenance procedures will not completely clean the implant surface. Even surgical treatment using chemical means might not completely debride the sintered surface. Bioactive coatings (HA) have also been used to decrease healing times and increase percentage of bone to implant contact. Although the roughness of these coatings is similar to that of TPS, an added problem is the dissolution or fracture of the coatings in the presence of inflammation. This could speed up bacterial colonization and bone loss, making timely treatment of these implants that much more important. Previous surgical treatment modalities involved both mechanical debridement (hand scaling, ultrasonics) and chemical surface treatment (tetracycline hydrochloride paste, 40% citric acid pH1, EDTA)<sup>13</sup>.

These modalities have significant shortcomings. With regard to mechanical treatment of the implant body, alteration of the implant surface could occur. Damage to the surface of the implant could delay or prevent bone re growth. Incomplete debridement of bacterial colonization and endotoxins could result in failure of grafted sites and a return of the defect.

If chemical surface treatment is used, tetracycline paste should be used only on titanium surfaces (CP or titanium alloy). If it is used on HA surfaces, it will interfere with the Ca-P bond of bone and could delay healing. It could, however, alter the crystalline surface making it more prone to breakdown after grafting. Ethylenediaminetetraacetic acid (EDTA) has been used to remove the organic smear layer on the implant body after treatment to eliminate granulation tissue in the osseous defect. A new paradigm for the treatment of the implant surface has been developed after the introduction of the Erbium, Chromium: Yttrium, Scandium, Gallium, Garnet (Er, Cr: YSGG) laser<sup>17</sup>. Previous lasers tested for potential use in oral implantology include Nd: YAG, Ho: YAG, GaAlAs, CO<sub>2</sub>, and Er: YAG. Most of these lasers, however, function in vaporization mode. High temperatures could alter or damage the implant surface making them inappropriate for use in treating the implant defect. They could also result in charring or coagulation of tissue, delaying the reparative cascade. The Er, Cr: YSGG laser, operating at 2780 nm, ablates tissue by a hydrokinetic process that prevents temperature rise<sup>22</sup>.

**Implant structure.** The design of the implant is an important factor in the onset and development of periimplantitis. Poor alignment of the components that comprise an implant prosthesis system may foster the retention of bacterial plaque, as well as enabling microorganisms to pass inside the transepithelial abutment. As Binon et al described in their study, this is possible because on average, there is a difference of between 20 and 49 micra between the components of the different types of implants currently on the market.

This space provides a point of entry for microorganisms of the oral flora measuring less than 10 micra. The external morphology of the titanium implant seems to be less relevant provided that it has been properly placed. However, the influence of the macroscopic design should be taken into account in terms of the pattern of stress transmission to the bone, which can lead to excessive mechanical stress at certain points, particularly at the junction between the bone and the cervical collar of the implant<sup>18</sup>. Bone loss at this biomechanically weak spot increases the likelihood of bone defect formation at this level and subsequently becoming contaminated. Another reported cause of peri implantitis is the corrosion that can occur when a non-noble metal structure is connected to a titanium implant. In these cases, increased amounts of macrophages have been observed in the tissues surrounding the implant; which would favour the initial bony reabsorption due to non-infectious causes<sup>12</sup>.

**Maintenance** In the first year following restoration of the implant, frequent recalls are needed. The client should be assessed every three months. Recall for the implant client after those initial 12 months should be dictated by the client's individual needs. These factors include stability of the implant tissues, periodontal health of the surrounding teeth, systemic health, and the effectiveness home-care procedures. Maintenance visits include periimplant evaluations, prosthetic evaluations, deposit removal, home-care reinforcement and modifications and radiographs when indicated. In the first year of treatment, radiographs of the implant should

be taken at each three-month recare visit. After that, an annual radiograph should be taken and compared to the baseline radiograph. Because of surgical trauma, it is reasonable to expect 1.5 mm of bone loss in the first year and 0.2 mm each year thereafter<sup>14</sup>. Excessive bone loss must be addressed immediately.

Implant mobility can be a sign of significant problems. Stability of the implant should be assessed at each re care appointment. Mobility can occur at the abutment prostheses connection and requires repair. Mobility of the implant body is more serious, as it implies a loss of integration. The prosthesis and attachments should be examined for adequacy and continued function. Mechanical difficulties in the prosthesis, such as a fracture, can cause excessive occlusal stress and contribute to periimplant bone loss. When faced with the ailing implant, one must first understand the etiology of the problem. The first qualification is to determine if the defect is of infective or biomechanical origin. If the implant is occlusally overloaded, the biomechanical parameter must be treated first. If the implant is surgically treated before addressing the occlusal problem, it is highly probable that the defect will not respond to treatment<sup>8</sup>. If the lesion is of infective origin without a biomechanical component, one must determine if the defect is purely a soft tissue problem or if it involves soft and hard tissue components. Ultimately, regardless of the etiology, only definitive treatment of the implant will provide a stable interface for possible long-term survival and function. There should be no undue force or occlusal stress on the implant. All surfaces of the prosthesis should be free of scratches, fissures, and gouges that can harbor bacterial plaque<sup>7</sup>. The evaluation of the health of the periimplant tissue should include clinical inspection for signs of inflammation. A review of several studies examining several types of instruments and their effects on the implant surfaces reveals the air-abrasive unit to be safe and effective in removing deposits. A rubber cup can be used to polish the implant surface with a nonabrasive paste or tin oxide. Superficial implant irregularities impede suitable mechanical control of the bacterial deposits located on the exposed implant surface. Optimal treatment for these failed implants should also include the regeneration of the tissue that has been lost around the implant. The treatment protocol will differ depending on whether it is mucositis or periimplantitis.

If there is no bone loss, i.e. in the case of mucositis, bacterial plaque and calculi should be removed and chemical plaque control is achieved with 0.12% chlorhexidine applied topically, every 8-12 hours for 15 days; the patient must also be instructed as to how he/ she can improve oral hygiene. Prosthetic design should also be checked and modified if necessary, in order to correct design defects that impede proper hygiene, as well as to correct the previously mentioned biomechanical stress factors involved. Once this initial phase is completed, periodic check-ups must be scheduled, gradually reducing the interval between maintenance visits. If periimplantitis is diagnosed, treatment will depend on the amount of bone lost and the aesthetic impact of the implant in question<sup>15</sup>. If bone loss is at an incipient stage, treatment will be identical to that prescribed for mucositis, with the addition of decontamination of the prosthetic abutments and antibiotics. If bone loss is advanced or persists despite initial treatment, it will be necessary to surgically debride the soft, periimplant tissues affected by the chronic infection, decontaminate the micro implant surface and, finally, apply bone regeneration techniques aimed at recovering the lost bone. Recommended surgical techniques will be performed on the basis of the morphology and size of the periimplant lesion. Reduction of bacterial plaques ability to adhere to the implant surface is also indicated; this can be achieved by smoothing and polishing rough surfaces or eliminating threads on implants. This technique is known as implantoplasty. The implant surface must be previously decontaminated in order to enable bone regeneration to take place, but also to permit the implant to osseointegrate again<sup>23</sup>.

### **III. Conclusion**

Treatment options for ailing and failing implants are varied. The clinician should start conservatively and progress to more aggressive therapy. The overall goal of therapy is to establish a functional restoration and acceptable esthetics. Therefore, any therapy provided should arrest further loss of bone support and re-establish a healthy peri-implant mucosal seal & attempts to eliminate osseous defects or to stimulate bone formation to regenerate lost supporting bone would be the ideal goal. The biological reaction of the implant to pathogenic bacteria can have an impact in the long-term success of the implant. It is for this reason that thorough examination of the implant structures at maintenance visits is indicated. Changes in implant health can indicate if the implant is ailing or failing, or has failed. There are various objective measures to assess the success of clinical procedures, clinical outcomes and long-term maintenance of treatment items. Those measures not only help in the quality care but also improve the quality of social and functional life of our patient.

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