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REVIEW ARTICLE

Peri-implant diseases: Treatment and management

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Abstract

One of the substantial changes in dentistry is the development of implant science. Along with the development of applications, implant science practitioners will face an inevitable challenge, which is how to deal with such problems. Recently conducted researches are more concentrated on surgical and prosthetic techniques, while the treatment for peri-implant diseases is still incomplete. Therefore, the aim of this review research is to provide a broad and descriptive overview on peri-implant diseases and to suggest the related treatments. Scientific articles were collected by electronic searching through EMBASE and Medline, and since controlled clinical trials were limited in this field, no limitation was imposed on the evaluated articles. Moreover, review articles and meta-analysis were used. For implants that bone resorption has affected <50% of the implant length, the evaluation is thoroughly recommended. Regarding cases with a range of <2 mm, the treatment plan will be more inclined towards non-surgical methods and should be treated by Peri-implant mucositis. If the bone resorption is >2 mm, surgical methods are proved to be more effective and in the cases which has extended >50% of the implant length, it is better to remove the implant. By increasing the range of annual dental implant, peri-implant diseases have become a serious challenge in this field. The proposed treatment plan will be a manual for dentists regarding on how to deal with implant problems; although further researches are required to approve the proposed protocols.

Keywords: Dental implant, disease, peri-implant inflammation

Introduction

The success of an implant treatment is approved through various studies;[1-4] however, further evaluation is needed on how to treat peri-implant diseases.

One of the confirmed causes of dental implant failure is bacterial plaque along with extensive loading.[5] Peri-implant diseases include non-specific inflammatory reactions that occur in host tissues;[6-9] while the cases of inflammation in soft tissues are known as peri-implant mucositis, which is often considered a reversible reaction.

Clinical characteristics of peri-implant mucositis include bleeding when being probed, peri-implant colitis, increase in probe depth (often as false pocket), or erythema, and redness of the implant that surrounds tissues.[10] It must be noted that symptoms are not necessarily limited to these cases. Moreover, when the inflammatory lesion strikes the bone, it is called peri-implant.[11] Peri-implant is an irreversible process and bone resorption in radiography, bleeding, pus discharge during probe, increased pocket depth, ache, or fistula are among its characteristics.[12]

A loose implant is considered as a "failed implant;"[12] while a "failing implant" is usually a progressive bone resorption with no looseness. It is a matter of the utmost importance to pay attention to practical differences of these two expressions. Dental implants may fail in various phases:

- Early failing: Occurs when the absence of initial osseointegration is due to the inability of reaching the primary bone to implant contact. Factors that can be suggested in this case include early loading, surgical trauma, or incomplete/inappropriate healing response (such as patients with immune suppression, AIDS).[13,14]
- Late failure: Happens after the initial integration of physiologic remodeling and loading. Bacterial infection and excessive loading are among the main factors in late failure.[15] Failure due to the first year of loading is not prevalent.[16]

Ailing implant, also defined as peri-implant biological problems, is referred to the limited diseases of peri-implant's soft tissue that do not affect the supporting bone tissues. On the other hand, losing non-progressive connections and no looseness are its characteristics.[17,18]

Peri-implant inflammatory processes are roughly similar to what happens around the tooth, except in the cases that peri-implant infections are initially less resistant to destruction due to the existence of the periodontal ligament.[19,20] In other words, unlike the presence of fibers that are vertically placed around the tooth, peri-implant fibers are mostly parallel because of the absence of cementum. Moreover, the blood supply in peri-implant has been reduced in comparison with tooth.[20] The aim of the present review article is to evaluate the causes of peri-implant diseases and its related treatment approaches.

Materials and Methods

By electronic searching through EMBASE and Medline, the scientific articles were collected and since controlled clinical trials were limited in this field, no limitation has been imposed on the evaluated articles. Moreover, review articles and meta-analysis were used. Words like mucositis peri-implant, treatment, peri-implantitis, and implant complications were used while searching for articles.

Results

The prevalence of peri-implant diseases was often suggested by retrospective studies.[21-23] Fransson *et al.*[24] indicated that >90% of peri-implant tissues have some inflammatory response. They have also reported 28% prevalence regarding the mentioned diseases.

Roos-Jansåker *et al.*[21] stated the prevalence of peri-implant mucositis as 48%, whereas 6.6% of implants have had the peri-implant. In general, defining the prevalence of peri-implant diseases is slightly difficult due to the application of various protocols, different follow-up periods, various implant systems, designs, and practical diameters. On the other hand, related information on implant placement area in terms of bone width and height or its position in the mouth cavity is not fixed in various studies.

It is said that the primary cause of inflammation in peri-implant tissues is the resultant infection of anaerobic bacteria.[25,26] Initial evolution of periodontal pathogens in the biofilm of implant levels is reported in edentulous people[27] and it is similar to what has been identified in tooth.[28-31] Periodontal pathogens could be colonized in implant level 14 days after mouth cavity exposition and a complicated subgingival microbial biomass will shape within 28 days after the implant exposition.[32] Sato *et al.*[33] has clearly shown the presence of most periodontal pathogens in bone resorption cases compared with peri-implant mucositis. Peri- implant inflammation could lead to bone resorption, and if it is not managed properly, it could cause implant loss. Furthermore, they illustrated in several cases that the existence of >5 mm remnant pockets after the treatment of active periodontal disease can increase peri-implant and implant loss.[34] This issue underlines the significance of accurate diagnosis in the initial phases of the disease and the necessity of appropriate and timely intervention.

Managing and treating peri-implant diseases

Controlling peri-implant diseases is a difficult and unpredictable process. One of the most important factors in their treatment is to evaluate implant looseness. The implant must be removed immediately if it comes loose during clinical check, after examining the possibility of abutment screw or prosthesis looseness.[15,18]

This type of decision-making is in line with Pisa implant health test criterion, in which three groups are introduced as implants status (compromised success, failure, and satisfactory).[12] In this classification, failure is considered as a loose implant. In general, looseness of the implant is the indicator of weakened bone-to-implant contact (BIC); therefore, a dentist must consider the situation as a criterion and instruction for deciding to whether keep the implant or not.

Treating peri-implant mucositis

When the implant is not loose, the next step is to identify the presence or range of bone resorption. If no resorption was detected, the diagnosis of peri-implant mucositis is highly probable, which is called Ailing implant.[18] On the other hand, if the bone resorption has occurred, we would be facing a peri-implant, known as failing implant. Peri-implant diseases, including peri-implant mucositis are infectious illnesses caused by Gram-negative pathogens in periodontal.[35-37]

Similar to the natural tooth, preventing the growth of biofilm and removing it from the implant must be the first phase in preserving the health of peri-implant soft tissue. Hence, treatment methods for peri-implant mucositis has nonsurgical basis and initially consist of mucosa and submucosa scaling. Synthetic treatments, including mechanical debridement and the application of non-microbial factors (such as chlorhexidine and essential oils), have been studied with caution to prevent damaging hemidesmosome joints at sulcus base and satisfactory results were obtained.[38-40] However, most studies have proposed the use of antiseptics, the effects of topical antibiotic agents, and irrigation with antibiotics as supplementary treatments in mechanical debridement.[41-43] The important point is that, studies have reported some significant advantages regarding the use of such agents in reducing index plaque. Schär *et al.*[44] indicated that the effect of nonsurgical treatments by photodynamic therapy is similar to topical antibiotic; however, removing the whole inflammation has not been seen in treatment methods.

Various surgical and synthetic methods were employed for surviving and treating ailing implant, which include debridement, decontamination of implant, and regenerative methods.[45-52] Nevertheless, determining the best treatment method is not possible due to the variety of clinical conditions.

Peri-implant treatment

Peri-implant is considered as one of the main concerns in implant treatment. This obstacle is about peri-implant bone resorption with no looseness. For successful treatment of this problem, dentists must realize the range of bone resorption as

their first step. Since the common two-dimensional radiographs have low sensitivity and cannot accurately identify the initial lesions,[53,54] implants prognostic evaluations are limited through these diagnostic methods. On the other hand, the treatment of implants with bone resorption is unpredictable in any way because the mechanical loading of these implants could endanger the long-lasting success.[55] In the cases of bone resorption extending to >50% of the length, it is highly recommended to remove the implant and after the reconstruction of hard and soft tissues and obtaining acceptable results, it could be replaced in the area. Although these conditions are treatable by guided bone regeneration, concerning the conducted researches in this field to achieve this osseointegration is extremely difficult and unpredictable.[56]

For implants with <50% bone resorption, the case must be evaluated accurately. If the resorption is <2 mm, design is administered by nonsurgical methods, which is similar to peri-implant mucositis treatment. Nonsurgical treatments have been evaluated by different strategies.[57-65] Mechanical debridement, regardless of the technique type, is not individually useful in removing the lesion and complete halting of peri-implant diseases.[57] In other words, conducted studies on dogs, in which suture was the cause of disease, has shown favorable results in the form of reduction in periodontal pathogens,[58] as well as improvement in clinical parameters such as probe depth reduction, adhesion improvement, bleeding on probe,[59] and plaque index due to mechanical treatment.

Synthetic treatments along with systemic antimicrobial (amoxicillin, metronidazole, tetracycline and clindamycin)[60,61] or topical antimicrobials[62,63] (tetracycline fibers, minocycline microspheres, and chlorhexidine gel) have shown a general reduction in number of pathogens and improvement of clinical parameters (index plaque, pocket depth, adhesion limit, and bleeding on probing [BOP]). Laser is suggested as an alternative to mechanical debridement[65] and encouraging results has been reported; however, there is limited information on functionality, useful dosage, and probable effects on the bone, which indicates further research is needed. Consequently, it is worth mentioning that the obtained improvements is limited to clinical parameters and as published in various numbers of researches, not a single case has received the treatment completely. Accordingly, we cannot treat an advanced peri-implant through only nonsurgical method, expecting successful and predictable results. Exception can be made when bone resorption is limited and healing is facilitated by nonsurgical methods. Surgical methods are recommended when the bone resorption is >2 mm but has affected less than half of the implant length. Serino and Turri[66] has stated that the success of surgical treatments in peri-implant diseases is related to the range of the initial resorption. The employed peri-implant surgical methods is similar to the applied methods in periodontitis and the basic principles, including the removal of pathogens, are used in all the mentioned issues.[25] If the aim of treatment is to preserve the bone, pushing the flap aside, similar to flap with apical position is performable.[59] Regarding cases in which bone contour modification is considered, bone surgical methods are recommended. In surgical methods, the basic treating principles are the decontamination of infected implants.[25] Nonetheless, retaining the integrity of the implant is a considerable challenge for clinicians. Various methods have been introduced for implants debridement. Favorable results were achieved in a study that chemical agents, such as metronidazole gel have been used as a flap.[59] Although the range of the obtained bone remodeling is minimum, evidences were presented to prove the functionality of abrasive pumices by electric toothbrushes with rotational motion for the purpose of decontamination.[67] The comparison of various debridement and decontamination methods, including Air-power abrasive, citric acid, normal saline, gas impregnated with chlorhexidine, or the combination of these methods, did not illustrate a significant difference in terms of bone regeneration and reintegration.[68] According to a case report, using flap surgery (along with decontamination by hydrogen peroxide) with systemic antibiotic have caused an improvement in clinical parameter (BOP) in the long-term and also halted the disease.[69] Irrespective of implant decontamination methods (the common mechanical methods, chemical agents, Air-abrasive, laser, saline, and ultrasonic), flap surgery with implant decontamination is a treatment which improves and subsidies inflammation, reconstructs the appropriate bone contour around implant, and halts the bone resorption. Bone respective surgeries around the contaminated implant (such as replacing implant levels, implantoplasty) can be performed along with respective surgeries for the contour modification and bone anatomy. The obtained results indicated that, implantoplasty has the potential for more improvement compared to debridement with prescribing antibiotics.[49]

To provide remission and achieve health status in surrounding implant tissues, reintegration is vital, and to reach that in a failing implant, various generative methods have been employed and different graft materials have been used to increase the range of BIC. Graft materials including xenografts, allografts, and alloplasts with/without membrane were used for this purpose.[46,47,51,70] These studies have shown the improvement of clinical and radiographic parameters as the reduction of probe depth and filling of the lesion. There is no strong evidence in this field to support the usage of membrane, while in cases that membrane is used, its exposition is reported as a relatively common problem.[67] Some studies proposed resorbable membranes to prevent exposure effects and reduce re-surgeries for removing non-resorbable membranes.[51,52] Currently, despite the lack of consensus on the privilege of a certain membrane, this is highly recommended. Dentists must carefully examine the clinical condition of patients and adopt the ideal treatment strategy based on the proposed methods.

There are various methods to prevent the outbreak of disease around an implant, especially in patients with periodontal records, sensitive to peri-implant diseases, and more susceptible to colonization of pathogens.[71-75] However, as long as the patient is in a good state of health and attends the follow-up sessions regularly, the issue is not a definite prescription for dental implants.[76,77]

It must be noted that peri-implant soft tissue inflammation is possible, even in patients with no periodontal record as well. Accurate elimination and the removal of remnant infection is a prerequisite treatment, since the remaining teeth can act as a source of periodontal and bacterial pathogens. Early pathologic detection is a significant factor in preventing disease progress and long retention of dental implant health. It is worth mentioning that the depth of peri-implant probing is not considered as a reliable method to check the health of a peri-implant[78] and radiographic evaluations are important, as well. Therefore, peri-implant probing and probe depth enhancement are related to adhesion loss and bone resorption,[79,80] which could be a suitable method for evaluating the adhesion limit. It must be noted that, the accuracy of evaluation methods is a limitation and also, bitewing and periapical radiographs are helpful in this field.[81]

Consequently, a decision tree has been defined to control peri-implant diseases to be used as a manual.[82-84] In order to treat and evaluate the peri-implant problems, long-term and periodical clinical and radiograph evaluations, along with their comparison to the criteria are needed. Since peri-implantitis and periodontitis are not curable diseases and relapse is probable, longtime retention periods in patients to control and prevent is the matter of the utmost importance.

Conclusion

By the increase in number of annual implant replacements, peri-implant diseases have become a challenge. The proposed treatment in this project will be a manual for dentists to confront the issue. To confirm the provided protocols, further studies are required in this field.

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