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Osseointegration and Re-Osseointegration.

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ABSTRACT

Osseointegration is the direct contact between the bone and the metal surface. Dental implants are placed to replace the edentulous space in the oral cavity. Osseointegration occurs between the dento-alveolar bone and the implant surface. It can be lost due to several reasons like clinical factors, patient factors, and local factors. Re-osseointegration is the establishment of *de novo* bone formation and *de novo* osseointegration. Similar to the treatment of periodontitis the peri-implantitis can be treated using surgical, non-surgical methods and using systemic antibiotics.

Keywords: Dental implants, osseointegration, peri-implantitis, re-osseointegration

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INTRODUCTION

Dental implants are inert, alloplastic materials embedded in the maxilla or mandible for the management of tooth loss and to aid replacement of lost oro-facial structures. The most common type of dental implant is endosseous which is also known as intra osseous and endosteal implants have become an important therapeutic modality in the last decade, mainly after the works developed by Branemark in 1960s, which has also been devoloped and refined continously since the very early designs of Chercheve in 1960 [1-3]. Dental implants are placed within dento alveolar or base bone. the direct contact between the bone functional tissues and the biomaterial titanium was termed osseointegration. To a portion of an implant that during the development of peri-implantitis suffered loss of bone-to-implant contact and became exposed to microbial colonization, the establishment of new bone formation and osseointegration is called re-osseointegration.

Causes for implant failure

Clinician dependent factors

Implant design

Implant length entirely depends on the amount of available bone. Available length of implants ranges from 7.0-20mm. Longer implants results in a higher success rate, in which there will be increased bone implant interfacial contact which provides greater mechanical resistance to masticatory forces [1,7,11,12]. Shorter implants exhibit less resistance to occlusal forces. Longer than 18mm may be predisposed to failure because of the tendency of bone to be overheated [7]. The circumference of the implant increases with the diameter. A thread surface has an even greater surface area than a smooth cylinder. The selection of implant dimensions depends on the width and depth of bone into which the implant is to be placed.

Implant spacing

Preserving an adequate blood supply to the bone is critical to dental implant success, it is essential to maintain adequate separation between implants and natural teeth [4]. Maximum number of implants should be placed to support a prosthesis so that occlusal forces will be distributed over as great an area as possible. It should be minimum separation of 3mm between natural tooth and implant to preserve the blood supply to the natural tooth's periodontal ligament. The clinical evidence suggests that implant should be placed 4.0-7.0 mm apart to avoid bone necrosis [1,4].

Surgical technique

Surgical trauma or limited surgical experiance is considered to be one of the most important causative factor in early implant failure [1,5,9]. The collagen is denatured and necrosis of bone cells occurs when bone is heated to 47degree celsius for more than one minute to lack of implant osseointegration [13]. The use of proper irrigation and sharp drills at low rotation can be employed to reduce heat generation.

Time of implant loading

Loading implants too rapidly is one of the most common causes of dental implant failure.[4,5,10] If loading does occur, the micromotion sustained by the implant may inhibit bone growth resulting in deposition of fibrous tissue repair and eventual loosening of the dental implant [6,8,15,41]. Branemark advises a stress free healing period of at least three to six months [42].

Immediate loading is advisable in case of completely edentulous patient, esthetically important location and in case of placing 10-13 implants and splinting them together where occlusal load is spread over the entire arch rather than issolated sites [43]. In a 2002repotr it is recommended that full osseointegartion should occur before dental implants are loaded to guarantee the greatest success [14].

Design of the prosthesis

The clinician should decide whether the prosthesis should be removable or fixed before placing implant. Removable device may be the treatment of choice for the completely edentulous arch. In case of single tooth replacement treatment of choice would be fixed prosthesis. Provided good bone quality and quantity more implants are preferred for fixed prosthesis. Using natural teeth in combination with dental implant is contraindicated [4, 44-46] Rigid implant with more elastic natural tooth and its supporting periodontal ligament may subject the implant to flexural forces. Conversely, it has been suggested that combining implant and natural tooth support for a prosthesis may enhance patient perception of masticatory force through proprioception, reducing the chances of overload as a result [47,48].

Patient factors

Diabetes

Diabetic patients experience delayed wound healing, which logically affects the osseointegration process. Uncontrolled diabetes inhibit osseointegration and lead to implant failure.

Smoking

Cigarette smoking is associated with significantly higher levels of marginal bone loss, and the effect of smoking status on the hard and soft peri-implant tissues has been clearly shown. The greater percentage of failures implant occurred in smokers (11.3%) than in non-smokers (4.8%).

Local factors

Bacterial infection can occur at any time during implant treatment leading to implant failure. Peri implantitis is a chronic, progressive, marginal and inflammatory reaction affecting the tissues surrounding osseointegrated implants that results in the loss of supporting bone. It accounts for 10% to 50% of all implant failure occurring after the first year of loading.

Peri-implant mucositis was defined as reversible inflammatory changes in the soft tissue.[16] It implies that the inflammatory process that occurs in peri-implantitis lesion is irreversible. The signs and symptoms of peri implantitis includes bleeding on probing, increased probing pocket depth, implant mobility, suppuration, pain and radiologic evidence of vertical destruction of crestal bone. It affects 5% to 20% of implant patients and is a major cause of implant failure [17-19].

Re-osseointegration

The goal of peri-implantitis treatment is to stop the progression of bone loss by controlling bacterial infection and peri implant tissue inflammation. The following have been suggested for the treatment [17].

- Removal of bacterial bio-film in the peri implant pocket.
- Decontamination and conditioning of implant surface.
- Elimination of sites that cannot be adequately maintained by oral hygiene measures.
- Regeneration of bone and re-osseointegration.

The treatment modalities include both surgical and non-surgical measures [20,21]. The non-surgical approaches includes [22-26]

- Oral hygiene instructions.
- Mechanical cleansing using polishing paste, rubber cups, ultrasonic carbon fibre curettes and acrylic scalers for biofilm removal.
- Antiseptic therapy with chlorhexidine solution or gel application.
- Antibiotic therapy with systemic anti-microbials or local application of antibiotic using controlled releasing device.

Surgical treatment of peri-implantitis involves either resective procedures which are preferred when there is minimal bone loss and regenerative procedures when there is major bone loss [27-33]. Surgical implantation of Recombinant human bone morphogenic protein -2 (rhBMP-2) has potential to promote bone formation and re-osseointegration in advanced peri-implantitis defects.

Effectiveness of mechanical decontamination

Management of peri-implantitis works on the principle that there is a primary microbial etiology in the form of bio-film on implant surface. Mechanical cleansing has been used for the treatment peri implant infections. The use of air borne particle abrasion to clean grit blasted titanium surface decontaminated with radioactive endo-toxin from E-coli shown to be effective in removing St. sanguis bio-film [35]. In a case study it was not recommended to use air borne particle abrasion instrument, since an acute clinical reaction characterized by pain, submucosal emphysema and breakdown of marginal bone was reported [40].

Plastic curette instrumentation caused no or minimal changes and considerable amount of re-osseointegration was reported. Using plastic scalers and saline irrigation a significant reduction in counts of A. actinomycetemcomitans, P gingivalis and P. intermedia can be achieved [34].

Effectiveness of chemical decontamination

Mechanical debridement can be combined with chemical agents to remove the bio-film. Citric acid is effective in reducing bacterial growth at a pH of 1, [17] highly acidic pH may affect peri implant tissues. Hydrogen peroxide swabbing for 1 minute followed by rinsing saline was another method in which direct BIC and re-osseointegrated were reported.

Pure titanium implants cleaned with cotton soaked in saline showed 64% bone regeneration [25] whereas in SAE showed 84% re-osseointegration.[38,39] Cleansing with saline resulted in higher re-osseointegration. Chlorhexidine and saline solution has been the better method to decontaminate implant surface.

Effectiveness of laser treatment and PDT

Non-surgical instrumentation with Er : YAG laser effectively removed sub gingival calculus without any thermal damage to explanted implants following peri-implantitis [36].

Photo sensitization using toluidine blue solution and soft laser irradiation is effective in eliminating peri implant pathogens like P. gingivalis, P. intermedia, A.actinimycetumcomitans [37].

CONCLUSION

Despite high success rate of endosseous implants, failures unavoidably occur. Peri operative contamination seems to be the most important cause of implant failure. Establishment of implant surface which favours bone formation and re osseointegration is a prerequisite for treating peri implantitis. Contaminants should be removed without modifying the implant surface. The combination of chemical and mechanical decontamination techniques should be applied along with regenerative surgical procedures to obtain optimum re-osseointegration by treating peri implantitis. Studies have shown that re-osseointegration of the contaminated implant surface is possible.

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