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Review Article

MICROBIAL LINK-BIOFILM AND DENTAL IMPLANTS

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ABSTRACT
Restoration of the lost natural tooth by dental implants has modernized the practice of dentistry. Dental Implants have improved the lives of many patients,but implant associated infection remains a serious complication with significance morbidity and mortality. Periodontal diseases and peri-implant disease are specific infectious that are originating from these resident microbial species when the balance between the host and microbial pathogenicity gets disrupted.This article focuses on understanding peri-implant microbiology and its role in peri-implant diseases.

Keywords: Bacterial Interaction, Plaque Development,Peri Implantitis ,Implant -Abutment Interface

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INTRODUCTION

Biofilm is microbial –derived sessile community characterized by cells that are irreversibly attached to a substratum or interface to each other ,embedded in a matrix of extracellular polymeric substances produced by microbes.[1] These biofilms allows the microorganism to stick and multiply on the surfaces. The interactions among the various bacterial species residing and growing in the biofilm takes place by metabolic exchange, physical contact, exchange of genetic information, signaling molecule-mediated information .[2] Biofilm formed on the tooth surface is called as dental plaque and the bacteria proliferating in the dental plaque form the main etiologic factors for the majority of the dental ailments, e.g., caries, gingivitis, periodontitis, and peri-implantitis. These ailments leads to tooth loss replacement of such lost teeth is essential to maintain the occlusal function,optimum oral health,esthetics,phonetics,facial support and masticatory needs. So in order to correct it,variuos methods like removable partial denture, fixed partial denture, and complete denture are being used since decades for replacement of missing teeth with natural or synthetic substitute. But all the methods have some problems which has lead to a new era in oral rehabilitation with introduction of osseointegrated dental implants. As osseointegration Implies 'direct structural and functional connection between ordered, living bone and the surface of load carrying implant'[3,4]. Dental implants are made from titanium because of its excellent surface properties and biocompatibility. During the transmucosal healing stage of titanium dental implants, the adsorption of salivary pellicle, bacterial accumulation and biofilm formation produce an inflammatory process[5] .The factors that influence the formation of biofilm are the composition and the speed of formation of biofilm and the surface energy ,roughness,chemical characterstics of the implant ,the abutment materials and the prosthetic components. It is important to note that periodontal diseases are infections that originate from indigenous microflora which accumulates on the dental implant surfaces and prosthetic restorations as a well developed biofilm and it has been cited as main cause of the dental implant failures[6.] The timing at which implant failures occur represents different physiological processes. Hence, an early implant failure indicates an initial lack of osseointegration due to an inability to establish an intimate bone-to implant contact. It can also be due to dental treatment involving biomaterials will alter the mechanical, physiological and chemical conditions in the oral cavity. So additional care should be taken to prevent the biofilm associated - infections in their patients.[7]

BIOFILM AND TOOTH

Biofilm formation in the oral cavity is a multistage journey where Bacteria acquire its nutrients from saliva.Acquired pellicle(i.e. thin film covering the tooth) ,is derived from the salivary proteins

and covers the enamel within nano seconds after brushing and the adherence of pellicle to the tooth surface is facilitated by the special surface molecules (adhesions) primarily of lectins which is present on the bacterial cell surface[8,9]. Further multilayerd bacterial colonies are formed from intercellular bacterial adhesion and secretion of extracellular polysaccharides eg. Levans dextrans,which is suspended in the polymer matrix.The bacterial cell colonizes on the tooth surface within 4 hours of pellicle formation .The initial colonizers are the streptococci (s. viridians, S. mitis, S. oralis).Secondary colonizers constitute predominantly of the Acinomyces species, S. mutans , S. sorbinus. bind to the bacteria.Bacteria multiplies and coaggregate with other species.Fusobacterium has the ability to aggregate with several bacteria and they form an important link in the dental biofilms bridging the early and late colonizers called as co-aggregation and these oral bacteria receive their nutrient supply from saliva, Gingival crevicular fluid, sugar rich food, metabolic products of other bacteria and food debris. There are two signaling compound through which Gram positive bacteria and Gram negative bacteria communicates and are responsible for the Quorum sensing which acts as a barrier for the bacteria against host immunity and the antimicrobial agents[10,11].

They are ,

1) "Competence stimulating molecule (CST) (small peptide molecule)
2) AI-2.

BIOFILM AND IMPLANT

Biofilm formation on dental implants and the teeth follow the similar pattern of microbial colonization[12].Biofilm formation around natural teeth occur within nano seconds after brushing and specific sites starts colonizing as early as as early as 2-6 hours and in case of implant surface, the pellicle forms as early as 30 minutes after the implant is exposed in the oral cavity.[13]The acquired pellicle on the dental implants owing to their lower albumin absorption capacity causes a low plaque formation around implants.[14] The implant surfaces lack the desired indigenous microbiota and demand the early colonizers to set the stage for the complex communities to develop. Early colonizers are predominantly the gram positive cocci, rods and actinomyces species.The periodontal pathogens colonizing on the streptococci (P.gingivalis, P. intermedia,etc) are the causative micro-organism responsible for peri-implantitis and periodontitis.[15,16] Many different studies have been performed evaluating the effect on biofilm formation from surface qualities such as surface energy,roughness,topography and chemical composition of the restorative materials.Surface roughness largely influence the osteointegration around the implant. However greater is the surface roughness higher is the rate of biofilm formation around the implant[17].The attachment of the micro-organism to the hard surface depend on their interaction with the surface components and certain specific charcterstics of the interacting surface in terms of their wettability /hydrophobicity and surface free energy (SFE)[14].

MICROBIOLOGY OF THE BIOFILM AROUND IMPLANT

Microbial colonization around the implant and subsequent inflammatory reaction are the key events involved in the pathogenesis of peri-implant diseases.Biofilm formation plays an important role in initiation and advancement of peri-implant disease and is necessary for the progression of infections around the dental implants. The microbiota in healthy periodontal tissue is predominantly gram positive facultative cocci and rods.S. aureus has high adhesion for titanium surface and has been associated with bleeding on probing and supparation. It interacts with a number of host proteins such as fibrinogen,fibronectin,collagen vironectin and laminin and they have been referred to as microbial surface components recognizing adhesive matrix molecule.[18,19,20] Microflora of the implant in peri-implantitis have a high prevalence of the red (P.gingivalis,T. forsythia,T.denticola) and orange complex (F.nucleatum,P.intermedia,Candida albicans) and they have been found to have increased adhesion to titanium implants in certain in-vitro studies.[21] Lipopolysaccharide present in the cell wall of gram negative bacteria stimulate T-lympocytes,monocytes ,macrophages to release cytokines in local inflammatory tissue infiltrates which play an important role in the development of peri-implant disease.Cytokines are glycoproteins and act as regulatory molecules at both local and systemic level.Cytokines such as IL-1,IL-6,IL-8,IL-12 and TNF-alpha act as proinflammatory factors which are responsible for bone resorption whereas IL-10 has anti-inflammatory function[22].

BIOFILM AT THE IMPLANT-ABUTMENT INTERFACE

Dental implants consists of an implant-abutment junction(IAJ).The joint and gap between the implant and abutment is called microgap(40-60micrometer).Ericsson et al, identified two important microbiologic entities in the implant crestal region (a) Plaque-associated inflammatory cell infiltrate (PalCT)and (b)implant-associated inflammatory cell infiltrate(IaICT) [23]when the implants are in contact with plasma or saliva ,the protein can direct the attraction or repulsion of bacteria present on external layers since protein have different degree of hydrophobic to hydrophilic regions.The main salivary protein absorbed to titanium in vivo and in-vitro is albumin and albumin adsorption to titanium occurs through calcium bridges[24,25] .This divalent ion calcium may serve as bridging agent in the adhesion of bacteria to titanium surfaces.The conclusive remarks of the study reveal that Implant abutment junction is a potential source of microbial contamination which affect the health and integrity of the biologic tissues around the osseointegrated implants[25].

CONCLUSION

As the pathogenesis of implant-associated infections has become more clearly elucidated ,the treatment modalities and the biomaterials used to mitigate infections have also evolved.Peri-implantitis has a multifactorial etiology in which oral biofilm is a recognizable etiologic agent. The reduction of the bacterial load to a level compatible with health is an important aspect of implant therapy.An implant's surface characterstics such as roughness ,surface free energy, and the chemistry have a significant influence on the pathogenicity of the peri-implant microbiota.In addition , the design features of dental implants and the composition of the biomaterials used to fabricate implants and abutment component play vital roles in bacterial colonization and biofilm formation.However, paradigm-shifting developments are currently being explored and may change the way in which we treat and prevent the growth of biofilm on implanted materials.

REFERENCE

1. Costerton JW,Montanaro L,Arciola CR.Biofilm in implant infection :Its production and regulation.Int J Artif Organs 2005;28:1062-1068

2. Kolenbrander PE,Palmer RJ.Bacterial interactions and successions during plaque development.Periodontology 2000 2006;46:47-79.
3. Saini R.Dental implants:A review .Res Res J Dent Sci 2013;1(3):8-11
4. Mampieri G,Ottria L and Barlattani A.Immediate –loading post extractive implant :indications,advantage and limits.Oral Implantology 2008;1(2):71-77
5. Kohavi D,Klinger A,Steinberg D,et al.Adsorption of salivary protein onto prosthetic titanium components.J Prosthedent.1995;74:531-534
6. Sharma M,Sharma M,Garg E.Biofilm on dental implants :A review .J Adv Med Scie Res 2015;3(2):132-136
7. Olio M,Bakken V.Biofilm and Dental Biomaterials. Mdpi.2015;10(8):2887-2900
8. Wolfe HF.Biofilm plaque formation on tooth and root surfaces.In:Wolfe HF,Ratetitschak KH,editor.Periodontology,Stuuttgart:Thineme;2005.p.24-30
9. Gibbons RJ,Van Houte J.On the formation of dental plaques.J Periodontal 1973;44-347-60
10. Kolenbrander PE,Anderson RN,Blehart DS.Communications among oral bacteria .Microbial Mol Bio Rev 2002;66:486-05
11. Bassler BL,Wright M,Silverman MR.Multiplae signaling system controlling expressions of luminescence in vibrio harveyii: Sequence and function of genes encoding a secondary sensory pathway.Mol Microbio 1994;13:273-86
12. Kalykakis GK,Nissengard R.Clinical and microbiological findings on osseointergrated implants ,comparison between partially dentate and edentulous subjects .European J Prosthod Rest Dent 1998;6:155-9
13. Tanner A,Maiden MF,Lee K.Dental implants infections.Clin Infect Dis 1997;25:S 213-7
14. Dhir S.Biofilm and dental implant:The microbial link.jisp.2013;17(1):5-11
15. 15)Steinberg D,Klinger A,Kohavi D.Adsorption of human salivary proteins to titanium powder.Adsorption of human salivary albumin.Biomaterial 1995;16:1333-43.
16. Mombelli A,Lang NP.Microbial aspects of implant dentistry .Periodontology 2000 1994;4:74-80
17. Teughels W,Van Assche N.Effect of material characteristics and surface topography on film development.Clin Oral Implants Res 2006;17:68-81
18. Harris LG,Foster SJ,Richards RG.An introduction to staphylococcus aureus and technique for identifying for identifying and quantifying S.aureus adhesions in relation to adhesion to biomaterial: Review .Eur Cells Mater 2002;4:39-60
19. Renvert S,et al.Clinical and microbiological analysis of subjects treated with Branemark or Astratech implants :A 7 year followup study.Clin Oral Implants Res 2008;19:342-7.
20. Socransky SS,Haffajee AD,Cugini MA.Microbial complexes in subgingival plaque .J Clin Periodontol 1998;25:134-44
21. Blankenship JR,Mitchell AP.How to build a biofilm:A fungal perspective .Curr Opin Microbiol 2006;19:342-7
22. Bormann KH,Stuhmer C,ZGraggen M.IL-1 polmorphism and peri-implantitis .Schweiz Monatsschr zahnmed 2010;120:510-515
23. Ericsson I ,Persson LG,Berglundh T.Different types of inflammatory reactions in peri-implant soft tissue.J Clin Periodontol 1995;22:255-61
24. Kohavi D,Klinger A.Alpha –amylase and salivary albumin adsorption onto titanium ,enamel and dentine:An vivo study .Biomaterials 1995,16,1339-1343
25. Klinger A,Steinberg D.Mechanism of adsorption of human albumin to titanium in vitro.J.Biomed.Master.Res.1997,36,387-392.
26. Sarita R,Tatara,D'souza RN.Evolving strategies for preventing biofilm on implantable materials.Materials Today.2013;16:177-182

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