Biological Forum – An International Journal **7**(1): 1622-1625(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Leakage at implant-abutment and subsequent implant mucositis: Literature review

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(Received 29 March, 2015, Accepted 27 May, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Over the past decade, with the advent of modern standards in the control of sterility within the operating room environment and adequate protocols of peri-operative antibiotic prophylaxis, the incidence of infections associated to orthopedic implants has become very low. Also, insufficient bonding of implants to bone tissues and bacterial infections lead to the failure of orthopedic and dental implants. The difficult battle to prevent and fight bacterial infections associated to prosthetic materials must be played on different grounds. A winning strategy requires a clear view of the pathogenesis and the epidemiology of implant-related infections. A major concern with antibiotic prophylaxis is the possibility of contributing to the development and spread of antibiotic resistant organisms. So, the purpose of the present review was to describe importance of leakage at implant-abutment and subsequent implant mucositis. It is important to identify crucial factors in this phenomenon. In this paper we tried to new strategies on minimize microbial infections in dental implants. We hope this literature review cast light on hidden side of prosthodontics.

Keywords: Microbial infections, Implant mucositis, Implant materials, Bone regeneration

INTRODUCTION

A. Implant materials

In dentistry, all-ceramic restorations are becoming a natural choice in all positions in the dental arch. The introduction of modern technology to manufacture dental restorations has generated opportunities to introduce materials that cannot be manipulated by traditional techniques. Francois Duret first described computer-assisted production of dental restorations in 1971. During the past decades, the development in the area of computer-aided design/computer-aided manufacturing (CAD/CAM) systems has accelerated. However, the number of reports related to accuracy and precision of CAD/CAM systems remains limited (Luthardt *et al.* 2001). The fit of a dental restoration depends on quality throughout the entire manufacturing process. Several factors affect the quality, such as preparation design, surface roughness, impression technique (Luthardt *et al.* 2006) production of a dental cast and, finally, when the restoration is complete, the cementation (Persson *et al*. 2006).

Hip or knee replacements, fracture fixation, ligament and tendon reconstruction and other surgical implant procedures have in recent years become valid and extremely common procedures to restore the function of affected joints, fractured bone segments and impaired limbs. In light of this enormous population of patients with orthopedic implants, even a currently low risk of infection, estimated to be in the range of 0.5-5% for total joint replacements (less than 1-2% in institutions with highly trained surgeons), has to be considered very relevant for its serious consequences. During the first 2 years following the interventions of total knee arthroplasty, infections have variously been reported as the second main cause of revision just after instability when not even the first one (Campoccia *et al.* 2006).

B. Leakage at Implant-Abutment

Leakage at the implant-abutment connection is a major contributing factor for peri-implant inflammatory reactions. Prevention of microbial leakage at the implant-abutment connection is a major challenge for the construction of modern two-stage implant systems in order to minimize inflammatory reactions and to maximize bone stability at the implant neck. Gaps and cavities inside the implant, between implant, and the abutment are still present, even in modern implant systems. The internal conical implant-abutment connection is considered to be mechanically more stable and tighter than flat-to-flat connections or tube-in-tube connections (Harder *et al.* 2010).

C. Bone regeneration

While peri-implant mucositis describes a reversible inflammatory lesion limited to the mucosa, peri-implantitis also affects the supporting bone circumferentially around an osseointegrated dental implant (Lang and Berglundh 2011). However, although these definitions are universally accepted, the diagnostic criteria still raise doubts. The critical parameter in the diagnosis of peri-implant mucositis is bleeding on gentle probing. Peri-implantitis lesions are characterized by irreversible changes in the crestal bone levels in conjunction with bleeding on probing with or without concomitant worsening of peri-implant pockets. Furthermore, suppuration is a common finding in peri-implant affected sites (Bassi *et al.* 2015).

Regular and adequate oral hygiene combined with non-surgical mechanical debridement (scaling and root planing) and, in some instances, additional operations using access flaps have been documented extensively to be successful in arresting the progression of periodontal tissue destruction. It has also been shown that antimicrobial treatment (systemic, topical, or combined) is useful in the treatment of peri-implantitis (B¨uchter *et al.* 2004).

D. Microbial infections

After implantation, bacteria move from periodontal pockets of remaining teeth and oral tissues (gingival, tongue, and tonsils) to colonize the implant surfaces (Quirynen et al. 2009). Bacterial plaque colonization of dental implants generally occurs first on the transmucosal abutment (Romeo *et al.* 2004). Adherence and colonization of the implant starts at surface irregularities supra-gingivally and spreads down the implant towards the base. Bacterial colonization of dental implants can lead to inflammatory reactions which prevent or result in loss of osseointegration. Peri-implant disease is the general term used to describe host tissue inflammatory reactions. There are two major types of peri-implant diseases: peri-implant mucositis and peri-implantitis. Peri-implant mucositis is defined as a reversible inflammatory reaction in soft tissues surrounding an implant (Klinge *et al.* 2005). Peri-implantitis is defined as an inflammatory process affecting the soft and hard tissues surrounding an osseointegrated implant resulting in rapid loss of supporting bone and associated with bleeding and suppuration (Albrektsson 1994). However, it is important to understand that a diagnosis of peri-implant disease is not synonymous with implant failure, i.e., an infection of the implant does not imply that the implant will fail. This is due in part to the lack of consensus by the dental community on the definitions or interpretations of terms such as implant survival, success, and failure, and because there are treatments that may be used in an attempt to stop infection progression (Norowski *et al.* 2009).

Microbial leakage is an important factor for chronic inflammatory infiltration and marginal bone resorption. Implant manufacturers aim to reduce the leakage by increasing the stability of the implant-abutment connection (Harder *et al*. 2010). Therefore, reducing the mobility of this connection by constructing physically tight connections with a high level of precision in the sub-micrometer range is considered to be an important precondition for microleakage prevention. Several investigators aimed to quantify microbial leakage of dental implants (Harder *et al.* 2010).

E. Antibiotic Strategies for Peri-implantitis

In the strategy for the prevention of infections, much has been done to improve the operating standards, minimize the possibility of contamination during surgery, reduce the establishment of infection by peri-operative antibiotic prophylaxis, and confine pathogenic strains by patient isolation. Along these directions further improvements can still be made, but little advancements in terms of decreased infection rates are being expected in return of this type of efforts (Lentino 2003). As a consequence, over the last 15 years, increasing attention has progressively been focused on the epidemiology and the pathogenesis of the infections, especially those associated to implant materials, in order to build knowledge and gain better control over this phenomenon (Campoccia et al. 2006).

The utilization of carriers for local antibiotic release is a very important aspect in the fields of therapeutic and orthopedic surgery, because meticulousness and surgical precision are not able to ensure the absence of infectious microorganism. In fact, the incidence of osteomyelitis makes implant removal essential for the prevention of further complications, such as loss of function and septicemia. Systemic antibiotic administration does not always allow for efficient concentrations, mainly because of poor blood flow in the bone tissue. This necessitates the administration of large antibiotic doses in order to obtain acceptable concentrations in the affected region. Therefore, biomaterials suitable for use as local drug-delivery systems are nowadays one of the most important topics in the medical literature.1-3 Implants able to deliver the drug in a higher concentration than minimum inhibitory dose will eliminate the pathogenic microorganism without risk of toxic overdose (Meseguer-Olmo *et al.* 2002).

F. Antibiotic resistance

Antibiotic resistance is currently a main issue requiring primary clinical attention. Many important pathogens, S. aureus in first line among them, have long been recognized to exhibit always more alarming levels of antibiotic resistance (Struelens *et al.* 2000).

Moreover, bacteria forming biofilms on prosthetic surfaces are per se particularly resistant to antimicrobials (Konig *et al.* 2001) and tend to survive to aggressive chemotherapy even in the absence of specific antibiotic resistance factors. In consideration of this, it may result clear how important is to survey the presence of antibiotic resistant strains at an orthopedic clinical setting, not uniquely with the scope to decide the patient treatment regimen. In *S. aureus* and *S. epidermidis* the resistance to blactams and especially those belonging to the penicillin group is nowadays extremely widespread (Campoccia *et al.* 2006).

Doxycycline. About four out of five strains do not respond any longer to penicillin drugs such as cephalosporins, while methicillin/ oxacillin resistance is observed in a lower but still conspicuous number of strains, close to four out of ten. The relevance of methicillin/oxacillin resistance is dilated by the fact that methicillin resistant bacteria do not respond to any of the numerous β-lactam drugs. Furthermore, methicillin/oxacillin resistant staphylococci frequently exhibit multi resistance also to several substances belonging to different antibiotic classes such as aminoglycosides, macrolides, lincosamides, tetracyclines, trimethoprim and sulfonamides (Liljenberg *et al.* 1996). This implies that the possibility to incur in isolates of these two very common species of staphylococci, which are not responsive to any of the known antibiotic classes but vancomycin, is real. Even though up to now never observed vancomycin resistance in staphylococcal orthopedic clinical isolates associated and non-associated to implant materials, such an event would have devastating effects in the absence of any valid medical treatment to control the infection (Campoccia *et al.* 2006).

Few researchers have attempted to compare these devices side-by-side, but in one study, doxycycline polymer, metronidazole gel, and perio Chip were compared in 47perio-patients. The study found that all controlled release polymer devices increased gingival attachment levels, but that there was a slightly greater improvement in patients treated with the doxycycline polymer (Snauwaert *et al.* 2000). There are extensive reviews of the local delivery agents available for periodontitis. In another study, investigators used the controlled release of doxycycline (AtridoxTM CollaGenex Pharmaceuticals, Newtown, PA) into peri-implant pockets and noted differences from scaling and root planning alone. This study also showed the efficacy of such devices in treating peri-implantitis. Patients who received the doxycyline treatment showed significantly greater probing attachment levels and lesser pocket probing depth and bleeding index than those who received scaling/ root planning alone.

However, clinical experience has shown that it is difficult to advance a local delivery device to the bottom of a deep peri-implant pocket (Mombelli 2002). This implies that simply using periodontal therapies to treat peri-implantitis may not be an adequate solution (Norowski *et al.* 2009).

CONCLUSION

Peri-implantitis caused by micro-organisms starts with inflammation of the mucosa surrounding the implant (mucositis), which is usually reversible. If left untreated, the inflammation spreads and results in vertical and horizontal bone loss and eventually in the loss of the implant. One of the key elements of treatment is to achieve a reduction or even eradication of periodontal pathogens. Researches confirm the relation between leakage at implant-abutment and subsequent implant mucositis revealed that bacterial resistance is the most important issue in infection during implant leakage. So, using the literature review of current paper, we started or incoming research project which the results will publish in recent future. This paper is heading of our recent research which based on that we want to investigate antimicrobial effect of Doxycycline on subsequent implant mucositis. So, we are trying to introduce new methods instead of old methods which have been used in marginal adaptation restorations in dentistry.

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