ORIGINAL RESEARCH

Comparison of Clinical and Microbial Profile of Osseointegrated Implants and Natural Teeth: A Pilot Study

[1]Melba Lisa D'Souza, [2]DV Nagarathna, [3]Poonam Wavhal

ABSTRACT

Implants have become an important alternative to conventional prosthesis for the replacement of missing teeth. With increasing demand for dental implants, failure is also being reported more frequently. Several factors, such as bacterial infection and excessive occlusal stress, are associated with the occurrence of the disease and influence microbial composition. Present treatment for gingival inflammation is directed at the removal of bacterial plaque or reduction of microbial composition. In case of implants this will not hold true. It is necessary to assess the biology and pathology of peri-implant tissues. Hence, this study is aimed at comparison of clinical and microbiological status of osseointegrated implants with that of a natural tooth.

Keywords: Osseointegrated implant, Peri-implantitis, *P. gingivalis, F. nucleatum, Streptococcus species.*

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INTRODUCTION

The principle reason for providing periodontal therapy is to achieve periodontal health and to retain the dentition. Dental implants have been shown to be an excellent method for replacing missing teeth. The use of osseointegrated implants has been increasingly accepted by both dental practitioners and patients with overall success rates in excess of 90%.[1] However, failure can occur occasionally, which can be attributed to occlusal overload and peri-implantitis caused by specific bacterial flora.[2] The incidence of peri-implantitis in inserted implants has been reported to be 2 to 10% in previous studies[3,4] while recent studies have shown peri-implant mucositis occurred in approximately 80% of the subjects and peri-implantitis was identified in 28% of the subjects.[5] Studies have indicated that peri-implantitis is characterized by a microbiota comparable to that of periodontitis.[6] Like natural teeth, dental implants are susceptible to inflammation of the supporting tissues by colonization of pathogenic bacteria. Mombelli and associates isolated an increased proportion of Gram-negative anaerobic rods in edentulous and partially edentulous patients, especially *Prevotella intermedia*, Fusobacteria and spirochetes.[7] Listgarten and Lai isolated *Bacteroides forsythus* (59%), spirochetes (54%), *Fusobacterium* (41%), *P. micros* (39%) and *P. gingivalis* (27%) around many of the failing implants in partially edentulous patients.[8]

Hence, the present study is designed to compare the clinical and microbiological changes between a natural tooth and an osseointegrated implant in the same patient.

MATERIALS AND METHODS

A total of 10 patients, aged 20 to 45 years of both genders, who underwent dental implant placement were included in the study.

The present study was carried out in the Department of Periodontology, AJ Institute of Dental Sciences, Mangalore, after obtaining approval from the ethical committee.

The selected patients for the study were required to fulfill the following criteria:

a. Presence of an osseointegrated implant of 6 months duration in any one quadrant and a contralateral natural tooth.
b. No underlying systemic disease that would be responsible for altered oral microflora.
c. None had received systemic antibiotic therapy in past 6 months or any antiseptic mouthwash.
d. None had received any mechanical periodontal prophylaxis for 3 months prior to study.
e. All patients were instructed to follow the modified Bass technique of tooth brushing.

In each patient, the test site was an osseointegrated implant site categorized as group A and the contralateral natural tooth was considered as the control site categorized as group B.

[1]Assistant Professor, [2]Professor, [3]MDS

[1-3]Department of Periodontics, AJ Institute of Dental Sciences Kuntikana, Mangalore, Karnataka, India

Corresponding Author: Melba Lisa D'Souza, Assistant Professor, Department of Periodontics, AJ Institute of Dental Sciences, Kuntikana, Mangalore-575004, Karnataka, India Phone: 9845425351, e-mail: dr.melbadsouza@gmail.com

CLINICAL PARAMETERS

Clinical examination consisting of recording case history and intraoral examination was performed for the patients by a single examiner. Periodontal status was assessed by using the following indicators:

a. Plaque Index by Silness and Loe (1964).
b. Gingival Index by Loe and Silness (1963).
c. Probing pocket depth with William's Graduated Probe.

PROCEDURE

Selected partially edentulous patients were subjected to implant placement for the missing tooth. Prior to implant placement, a detailed case history of the selected patients was recorded and they were subjected to oral prophylaxis using Dentsply Cavitron. After placement of the implants, all patients were presented with the same brand of tooth paste and brush, and were asked to continue the same till the date of sample collection. All patients were demonstrated the Modified Bass Technique by the clinician and later asked to reproduce the same. Patients were recalled after 6 months for plaque sample collection. The patients were recalled every month to evaluate their oral hygiene status and monitor their brushing technique. No other therapeutic intervention was carried out. Clinical assessment was done using the above mentioned indices (plaque index, gingival index, probing pocket depth) on the day of sample collection.

MICROBIAL SAMPLING

Bacterial examination was carried out by subgingival plaque sampling. Prior to obtaining the sample, supragingival deposits were removed and the site was isolated with cotton rolls to minimize contamination. A sterile plastic curette and Gracey curette were used into the deepest pocket depth of the corresponding implant and contralateral natural tooth respectively. The pooled sample was transferred into a transport media, i.e. thioglycollate medium with hemin and Vitamin K after which it was sent for the quantification of *Porphyromonas gingivalis*, *Fusobacterium nucleatum* and *Streptococcus* species by bacterial culture. Each sample was then placed in a nonselective media, i.e. supplemented blood agar and also in kanamycin blood agar which is a selective media for *P. gingivalis*. A 1:10 dilution of each sample was taken and incubated anaerobically for 72 hours. It was then analyzed for black pigmented organisms. Fluorescence along with biochemical reactions were also carried out. After all, the tests were completed, the number of colony forming units/ml were recorded for the organisms, namely *P. gingivalis, Fusobacterium nucleatum* and *Streptococcus* species.

The periodontal parameters were correlated with the microbial findings and the collected data was subjected for statistical analysis using Mann-Whitney U test.

RESULTS

We detected *P. gingivalis* in eight of the control sites and five in the test sites while *F. nucleatum* was detected in 4 of the control sites and 5 of the test sites. *Streptococcus* was detected in all the 10 patients, in both the control and test groups.

The interquartile range for the control group of *P. gingivalis* was 86,750 while that of the test group was 80,000.

The interquartile range for the control group of *F. nucleatum* was 40,000 while that of the test group was 1,75,000.

The *Streptococcus* group showed an interquartile range of 2,85,000 for the control group and 1,20,000 for the test group.

These descriptive statistics including mean and standard deviation suggest that the presence of *F. nucleatum* was considered as significant with a p-value of 0.014 while the presence of *P. gingivalis* and *Streptococcus* was nonsignificant ($p = 0.016$ and $p = 0.208$ respectively).

DISCUSSION

The use of oral implants in the rehabilitation of partially and completely edentulous patients is widely accepted. The chance for implants to integrate can be jeopardized by the intraoral presence of bacteria and concomitant inflammatory reactions. The longevity of osseointegrated implants can be compromised by occlusal overload. Plaque induced peri-implantitis depends on the implant geometry and surface characteristics. Various cross sectional studies and longitudinal observation in humans indicate that peri-implantitis is characterized by a microbiota comparable to that of periodontitis.[9]

Our study consisted of selected 10 osseointegrated implants, each with a contralateral natural tooth. All patients with at least one dental implant, no history of systemic disease or systemic antibiotic mouth rinses for the last 3 months, no history of smoking and no history of periodontal therapy for atleast the last 3 months were selected. The main objective in carrying out this study was to compare the clinical and microbiological status of osseointegrated implants and contralateral natural teeth.

The present results revealed that there was a statistically significant presence of *F. nucleatum* around the osseointegrated implants. However, the presence of *P. gingivalis* and *Streptococcus* was shown to be nonsignificant. The clinical parameters were not indicative of deteriorating support or implant failure.

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.[10] Implant failure has been defined as the inadequacy of the host tissue to establish or to maintain osseointegration.[6] 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. Studies have shown that the bacterial flora at the failing implant sites consist of Gram-negative anaerobic bacteria including *Porphyromonas gingivalis, Prevotella intermedia and Aggregatibacter actinomycetemcomitans*, which resemble the pathogens in periodontal disease.[11] However, the presence of these organisms does not necessarily result in the development of peri-implantitis, but the presence of other co-factors is required as well. These include occlusal overload, surgical trauma, faulty or incorrect prosthetic design and/or improper surgical placement. The other etiological factors are patient related factors that include systemic diseases, such as diabetes mellitus, osteoporosis, etc. social factors, such as inadequate oral hygiene, smoking and drug abuse, parafunctional habits, such as bruxism and iatrogenic factors, such as lack of primary stability and premature loading during the healing period.[12]

The major role in bacterial colonization of the peri-implant is the periodontal pockets, which serve as a bacterial reservoir. For this reason, Steenberghe et al pointed out that for durable function of the implant, supported reconstruction is necessary to keep the periodontium healthy with regard to proper hygiene and regular check ups.[13] It seems reasonable, that every partially edentulous patient receive appropriate periodontal treatment prior to placement of dental implants to reduce or eliminate suspected periodontal pathogens and be maintained on an individualized recall schedule for supportive periodontal therapy.

Drake et al studied the ability of *Streptococcus* species to colonize on the surface of implants in terms of wettability, roughness and modes of sterilization.[13] The osseointegration around the dental implant is largely influenced by its surface roughness: greater is the surface roughness, higher is the rate of the biofilm formation around the implant. The attachment of the microorganisms to the hard surfaces, i.e. teeth and implants, besides their interactions with the surface components also require certain specific characteristics of these interacting surfaces in terms of their wettability/hydrophobicity and surface free energy.[14] Hence, future research is required to design implant surfaces that inhibit or reduce the bacterial adhesion.

CONCLUSION

It can be concluded that dental implants are not immune to infections. Like natural teeth, dental implants are colonized by bacteria. Peri-implantitis can be considered as multifactorial. A complex interplay between the bacterial challenge and host factors determines whether a rapidly progressing peri-implantitis develops, leading to implant failure. Specific microorganisms may play a role in initiating this process but more likely are important in its maintenance or its progression. Success of the implants lies on a successful osseointegration, for which sufficient subsequent continuous maintenance for reduction of periodontopathogens is necessary. No matter what the studies show, it is wise to be cautious in placing dental implants in subjects with periodontal disease.

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