

## Interrelationship between Periodontitis and Peri-Implantitis: Myth or Reality?

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### Abstract:

**Introduction:** With the evolution of treatment strategies over the years, we have come a long way from the era of removable partial dentures for edentulous ridges to implant supported superstructures in the current times. Implants have shifted from a complex and expensive option to a first line and feasible choice. So it has become the need of the hour to weigh the potential risk factors for the placement of implants. Peri-implantitis is one such factor causing the late failure of implants. Thus it is elaborated here to aid in proper treatment planning.

**Clinical Significance:** Periodontitis is one of the leading causes of tooth loss all over the globe. It is said to have a multifactorial etiology making it often difficult to understand and treat. After loss of teeth either partially or completely, the question arises that will the implants which replace the missing teeth also face the same fate and have peri-implantitis causing implant loss. Thus it is clinically relevant to examine the relationship between periodontitis and peri-implantitis.

**Material and Methods:** This article included longitudinal studies comparing periodontal status of subjects with and without periodontitis. Screening of studies and extraction of data were carried out independently and in combination of both. Outcome measures examined were implant survival/failure, peri-implantitis, probing pocket depth and plaque index.

**Summary and Conclusion:** Most studies show conflicting results to arrive at a definitive conclusion. There are insufficient long term studies with proper controls. Some evidence points to a history of severe chronic generalized periodontitis and aggressive periodontitis causing peri-implantitis. Contrarily few studies show a successful survival of implants in subjects who have lost teeth due to periodontitis previously provided they are on a regular maintenance regimen. Thus it requires a more comprehensive research to formulate a universal protocol.

**Keywords:** Bone loss, Denture, Implants, Periodontitis, Peri-implantitis, Tooth loss.

### Introduction:

As we complete a decade and enter into another in the 20<sup>th</sup> century, so have implants as a pivotal treatment segment. More and more sections of the population are now utilizing them for a better quality of life. They in turn, are not without their set of pitfalls. Among the reasons of failure of implants a large percentage is allocated to peri-implantitis.<sup>1</sup>

Peri-implantitis is an inflammatory process affecting tissues around an osseointegrated implant in function that results in loss of supportive bone. The nature of peri-implantitis is very similar to periodontitis. It is only natural to question, whether patients with an increased susceptibility to periodontitis would have an increased susceptibility to peri-implantitis and implant loss (i.e. decreased survival or success rate of implants) even in partially dentate patients who have been treated for periodontitis. This is relevant because periodontitis is one of the leading causes of tooth loss and dental implants are increasingly used to replace missing tooth in such patients.<sup>1</sup> Consequently, a history of past periodontitis may act as prognostic factor for future survival and success of dental implants.

Thus the purpose of this paper is to peruse the role of a previous history of periodontal disease thoroughly in aetiology of peri-implantitis. The ultimate goal is to come up with appropriate solutions for the same so as to improve the overall longevity of the dentition.

### Materials and Methods:

#### Study Selection

This review included all the longitudinal studies comparing periodontal status/peri-implant status in patients with and without periodontitis. The periodontal parameters taken into consideration were probing depth, clinical attachment level, radiographic assessment of bone loss and microbiological assay. The duration of longitudinal studies had to be a minimum of three years and above after placement of implants. The peri-implant parameters were probing depth, bleeding on probing, implant survival and success. Studies given preference were the ones where subjects were on regular maintenance.

#### Search Strategy

The literature was searched using MEDLINE and PubMed databases for studies up till June 1, 2012. The search terms used were 'Periodontitis', 'Periodontal diseases', 'Alveolar bone loss', 'Dental implants', 'Peri-implantitis' and 'Tooth loss'.

The search was carried out in English language and unpublished data was not included. Hand searching involved periodontal, implant and general dentistry journals Clinical Oral Implants Research, International Journal of Oral & Maxillofacial Implants, Journal of Clinical Periodontology, Journal of Periodontology, Periodontology 2000.

### Outcome Measures

There are two types of outcome measures namely primary and secondary outcome measures.

**Primary outcome measures:** This includes implant survival, implant failure, implant success and peri-implantitis.

**Secondary outcome measures:** They are plaque index and maintenance care.

**Implant survival:** Survival rate is certain percentage of implants still present in the mouth at the end of observation period.

**Implant Failure:** Failure rate is number of losses divided by the sum of lengths of time at risk for each implant.

Implant success is as defined by the criteria by Albrektsson<sup>3</sup> et al (1986):

1. Absence of mobility
2. Absence of persistent subjective complaints (pain, foreign-body sensation and/or dysesthesia)
3. Absence of recurrent peri-implant infection with suppuration
4. Absence of continuous radiolucency around the implant
5. No pocket probing depth (PPD) > 5mm
6. No PPD ≥ 5mm and BOP
7. After the first year of service, the annual vertical bone loss should not exceed 0.2mm (mesially or distally)
8. A success rate of 85% after 5 years and of 80% after 10 years.

**Success rate:** It is number of successful implants divided by total time at risk for each implant.

**Peri-implantitis:** It is defined as incidence of PPD ≥ 5mm with BOP and radiographic signs of bone loss<sup>4</sup>

### Confounding Factors:

Smoking, Systemic disease (e.g. diabetes mellitus, osteoporosis), medications (e.g. Anticoagulant medications, long standing steroid medication) and radiotherapy or chemotherapy. These should be adjusted in multivariate analysis.<sup>5</sup>

### Study Selection Results:

The basic search provided 159 titles for consideration and 18 were selected after screening of abstracts. After rejection due lack of a control group and follow up care only 7 studies were finally included.

### Early and Late Implant Loss:

Early and late implant loss have different aetiopathogenesis and thus their interaction with periodontitis is different.<sup>6</sup> Early implant loss is inability to establish osseointegration defined as a "direct structural and functional connection between ordered living bone and the surface of a load-carrying

implant.<sup>7</sup> The causes for early loss are patient related factors namely smoking<sup>8</sup>, bone quality<sup>9</sup>, osteoporosis<sup>10</sup>, systemic diseases or chemotherapy<sup>11</sup>, surgical trauma and bacterial contamination during implant insertion.

Causes for late implant failure are peri-implantitis which is the inflammatory process affecting the tissues around an osseointegrated implant in function, resulting in loss of supporting bone and eventually in late implant loss<sup>12</sup> and implant fracture or loss of implant due to occlusal overload.

### Evidence for Correlation of Periodontitis and Peri-Implantitis

Before analyzing the studies on periodontitis and peri-implantitis some of the discrepancies in them have to be outlined namely:

- There is a lack of an exact classification system for periodontitis patients<sup>13</sup>
- Most studies do not have a healthy control group
- The limited number patients included
- The duration of follow up period is variable
- Lack of data on Bop and/or Pocket Probing Depth
- Large percentage of dropouts
- Mostly no maintenance program is mentioned
- The retrospective nature and difference in prosthetic superstructures
- Including completely or partially edentulous patients in the same study
- Multifactorial risk assessment not provided<sup>14</sup>

A total of 59 recalcitrant patients with 309 implants constituting 132 mandibular fixtures and 177 maxillary fixtures were studied. Four mandibular and three maxillary implants failed with an overall success rate of 98%. The recalcitrant periodontal patient is defined one who has not responded positively to traditional periodontal therapy and continues to lose attachment apparatus and teeth. The results demonstrated 100% prosthesis stability and suggest the efficacy of the implementation of osseointegration as a treatment modality for this difficult category of patients.<sup>15</sup>

This study was of 3 years duration and comprised of a total of 39 partially edentulous subjects. Among them 15 patients were treated for generalized aggressive periodontitis (GAgP), 12 patients for generalized chronic periodontitis (GCP) and 12 were periodontally healthy. There was a 3 month recall interval to examine all the clinical parameters and microbiological analysis in the form of dark field microscopy and DNA analysis. Radiographic examination was carried out at baseline, immediate post-insertion of superstructure,

and then 1 and 3 years later. The 3-year implant success rate was 100% in the periodontally healthy and GCP patients, and 95.7% in the maxilla and 100% in mandible of GAgP patients. The high 3-year success rate of 97.4% shows that implants can also be used successfully in patients treated for aggressive periodontitis with regular maintenance. However continuous attachment loss was recorded in the GAgP patients. Although moderate bone loss was recorded in all the subgroups the greatest bone loss was in GAgP patients. The 3 year success rate was high in all groups though the possibility of periodontal disease progression cannot be ruled out in the GAgP patients.<sup>16</sup>

A continuation of the aforementioned study by Mengel of 3 years follow up comparing periodontally healthy, chronic periodontitis and aggressive periodontitis subjects was of 5 years duration. But in the present study only aggressive periodontitis subjects were followed using clinical, microbiological and radiographic parameters. There was a clearcut attachment loss in GAgP patients in both teeth and implants in fourth and fifth years. The implant success rate in GAgP patients was approximately 10% below that of CGP patients.<sup>17</sup>

The longitudinal study mentioned here had an advantage of a very large sample size of 1060 patients with a total of 5787 implants placed in these patients. Clinical and radiographic examination with an emphasis on periodontal examination at the end of study period was carried out. Overall 28 implants were lost during the study period. The periodontal disease status of failing cases revealed that 16 out of 23 patients presented chronic or aggressive periodontitis. Amongst them 8 patients had generalized severe chronic periodontitis, 4 had generalized and moderate chronic periodontitis and remaining 4 had localized aggressive periodontitis. The two major risk factors summarized for implant failure in this paper were implant staging (two-stage implants) and use of special techniques.<sup>18</sup>

Hardt and colleagues divided patients into groups of 25 each representing the highest (periodontitis) and the lowest (periodontally healthy) quartile of bone loss around the teeth at baseline. The implants in periodontitis group had  $2.2 \pm 0.8$  mm bone loss and  $1.7 \pm 0.8$  mm bone loss around periodontally healthy group at the end of 5 years study period. They reported an overall implant survival rate of 94.8%, with 92.0% implant survival in periodontitis subjects and 96.7% in periodontally healthy subjects. There was however, no mention of smoking habits, probing pocket depth and frequency of maintenance.<sup>19</sup>

This is a longitudinal study which followed Titanium Branemark implants in partially dentate patients for 10 years wherein clinical, radiographic and microbiological parameters were assessed to

elucidate the peri-implant health situation over time. Most patients history showed that they had been treated for advanced periodontitis previously. The primary periodontal pathogens namely *Porphyromonas gingivalis*, *Prevotella intermedia* and *Aggregatibacter actinomycetemcomitans* were studied. A total of 3 implants two maxillary and one mandibular were lost in ten year period. But in this study patients were on a strict maintenance program. The results show that in spite of presence of putative periodontal pathogens there is no effect on the long term survival of implants.<sup>20</sup>

In the Karoussis et al 2003 paper periodontitis patients who were treated for the same were compared with non-periodontitis patients. Loss of teeth due to periodontitis was the group with periodontitis (PG) and loss due to other reasons (caries, fracture or trauma) or agenesis was non-periodontitis group (NPG). The incidence of peri-implantitis was 28.6% in the PG and 5.8% in the NPG patients. Survival rate for the PG was 90.5% while for the NPG it was 96.5%. The difference in survival rate though existent between the groups did not reach statistically significant levels.<sup>4</sup>

Patients with implants on supportive periodontal therapy having a history of periodontitis were assessed. The incidence of early implant loss was low. The proportion of late implant losses for patients with history of periodontitis is high varying from 0% to 41%. More in implants with rough surfaces. Patients with aggressive periodontitis and or very rough surface seem to be more susceptible to peri-implantitis/late implant loss.<sup>21,22</sup>

### Discussion:

The evidence for association between periodontitis and peri-implantitis was searched systematically and included in electronic databases and hand searching of relevant journals. Seven studies were accepted for review. However follow up maintenance care has been mentioned only in four of the studies.

There was variation in the primary outcomes among the various studies selected. The two studies by Mengel et al where even aggressive periodontitis cases were included as a category the 5-year data is only presented for the aggressive periodontitis group and chronic periodontitis group is only followed up for 3 years. The 5-year implant survival rate was 88.8%.<sup>16,17</sup>

Only two papers i.e. Hardt et al and Karoussis et al have a proper sub-division of subjects into periodontitis and non-periodontitis group. The Karoussis paper concludes that periodontitis group are more susceptible to peri-implantitis as evidenced by greater bone loss compared to the non-periodontitis group.<sup>4</sup> The study

by Hardt et al the implant survival rate was found to be higher in periodontally healthy subjects.<sup>19</sup>

### Modifications in clinical approach

There is limited evidence that patients treated for periodontitis might experience more implant loss and complications around implants including higher bone loss and peri-implantitis than non-periodontitis patients. Consequently, appropriate consent should be obtained before implant therapy.<sup>5</sup>

The younger the patient the steeper is the progression curve for progression of peri-implantitis, the more important it is to interfere with the progress of the periodontal disease to delay implant installation and, once implant treatment has been performed, to follow the patient with peri-implantitis measures. Repeated cause-related therapy may help in long term.<sup>23</sup>

To obtain the best possible long-term prognosis, clinical decision-making for optimal treatment in periodontitis –susceptible patients should be based on evaluation of:

Periodontal disease severity and progression, functional and esthetic demands, patient plaque control ability and patient compliance, risk factors for technical and biological failures, treatment complexity and costs. The risk assessment pyramid should be referred to for arriving at a blueprint for definitive treatment protocol<sup>24</sup>

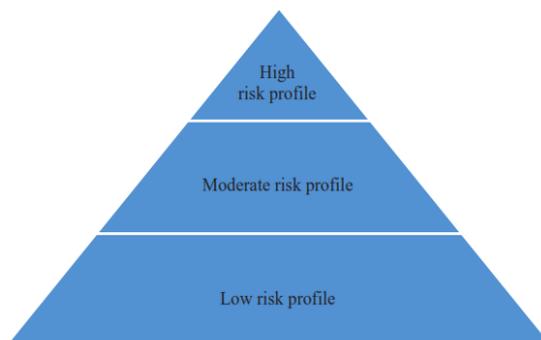


Fig: The combined patient and site risk assessment could be described as a pyramid where the majority of patients would be allocated at a low or moderate risk profile for implant complications, with only a small percentage of subjects presenting high susceptibility to periodontitis and thereby a high-risk profile for implant complications. Possible scenarios for the different risk profiles can be described as follows: High-risk profile – Patient level: presence of aggressive or refractory periodontitis, high plaque and bleeding on probing scores and smoking. High esthetic demands and high treatment costs. Site level: compromised alveolar bone quality and quantity with need for hard and soft tissue augmentation, with neighboring teeth

presenting with residual pockets  $\geq 5$  mm and bleeding on probing. Suggestion: restoration with implants should be avoided. Moderate-risk profile – Patient level: previous periodontal disease overall successfully treated but the patient still presents a limited number of residual pockets and the oral hygiene might not be always optimal. Patient prepared to accept compromised esthetic outcome and is able to afford a moderate / high-cost restorative solution. Site level: suboptimal local alveolar bone availability not requiring extensive augmentation procedures. Neighboring teeth might require periodontal retreatment. Suggestion: restoration with implants should be delayed until periodontal conditions are stable. Low-risk profile – Patient level: Systemically healthy, patient has responded very favorably to periodontal therapy with optimal oral hygiene, has low functional and esthetic demands with no cost related concerns. Site level: adequate bone quantity, neighboring teeth periodontally and endodontically stable. Suggestion: restoration with implants is possible.

A decisive component in a periodontitis affected patients long term prognosis is plaque control efficient enough to maintain healthy periodontal tissues. Finally periodontitis susceptible patients should have annual comprehensive examination.

### Conclusions:

Consensus from studies on chronic periodontitis:

Long-term survival rates of implants placed in partially edentulous patients with a history of chronic periodontitis may exceed 90%, being comparable to the mean implant survival rates reported for general population. PPD around implants placed in patients with a history of chronic periodontitis tends to increase throughout the study period than in periodontally healthy subjects. Implants placed in patients with a history of chronic periodontitis may demonstrate a higher incidence of peri-implantitis than implants placed in patients without a history of periodontitis.<sup>22</sup>

Consensus from studies on aggressive periodontitis:

The short-term implant survival rates for patients treated for aggressive periodontitis may exceed 95%, reaching up to 100%. Clinical attachment loss appears to be significantly greater in aggressive periodontitis patients. Alterations in clinical parameters around teeth and implants in aggressive periodontitis patients may not follow the same pattern, in contrast to what has been reported for non-aggressive periodontitis subjects. This hypothesis has to be tested by further investigations on long-term basis.<sup>22</sup>

There are general discrepancies of parameters between the studies included here namely

the low number of subjects included, the varied definition of what are 'periodontitis patients', the lack of proper controls and scarcity of information on maintenance care of patients making it extremely difficult to reach a firm conclusion. The limited data, however indicate that outcome of implant therapy in periodontitis subjects may be different compared to individuals without such a history as evidenced by loss of supporting bone and implant loss.

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