

On Crestal/Marginal Bone Loss Around Dental Implants

Recently published reports¹⁻⁵ as well as a consensus statement⁶ have suggested an alarming increase in inflammatory responses around dental implants that are accompanied by variable levels of marginal bone loss. These responses are popularly referred to as an escalating disease entity—so-called “peri-implantitis.” This emerging mindset poses serious questions for the long-term viability of the osseointegration technique if the condition indeed exists in a primary form. However, the bulk of the existing literature related to osseointegration has not described peri-implant gingivitis with accompanying marginal bone changes in such dramatic terms. In fact, it has been well documented that failure to induce and maintain long-term osseointegration actually occurs in less than 5% of treated patients. Moreover, clinical outcome studies have not routinely described complications related to progressive soft or hard tissue deterioration. Consequently, the current emphasis on the significance of peri-implant bone loss represents either an ignored phenomenon or is an overtly pessimistic interpretation of or emphasis on a somewhat rarely occurring event. In an effort to determine which of these dichotomous occurrences more closely resembles the truth, an independent initiative sought to evaluate questions related to soft and hard tissue damage adjacent to dental implants.

To accomplish this, a small international and independently acting study group of established clinical scholars was formed. It was felt that their collective long-term clinical and research experiences with dental implants would provide scope for a prudent and objective synthesis of relevant analyses and concerns related to this topic. Funding for this “mini-symposium” was provided by five implant manufacturers* who endorsed the names of the nine selected participants who would play the role of the conference jury, together with this introduction’s three authors. Four scientific reporters were also invited to present background review papers on different aspects of the topic. The reviewed literature was regarded as a valid representation of the larger volume of published literature rather than a robust systematic review of it. The background information was synthesized into compilations to assist in consensus development.

The published literature indicates clinical success for turned, machined implants with no apparent significant differences in marginal bone loss between such implants and currently used moderately rough-surface ones. It is noted, however, that specific behavioral conditions, eg, smoking, resulted in less favorable outcomes with machined implants while not influencing the outcome of moderately rough surfaces over the long term.⁷ Likewise, a compromised situation, such as that necessitating the use of very short implants, led to a significantly less favorable outcome for machined implants while not affecting results for moderately rough surfaces.⁸ Similarly, the more challenging maxillary implant placement

demonstrated better clinical results over 5 years or more of observation when moderately rough implant surfaces were used. Other challenging conditions such as direct loading or placing implants in irradiated bone or grafted sites revealed significant long-term advantages for currently used surfaces over the original machined ones; however, in these conditions the clinical documentation is limited to short-term data with relatively weak study designs.

Collective clinical observations also suggest that marginal bone loss is associated with biologic failure of osseointegration rather than discipline-driven etiologies of periodontal disease or occlusal overload. It must also be recognized that numerous factors may challenge both early and late interfacial responses that could lead to marginal bone loss. Alternative considerations now include the infrequent eventuality of osseoseparation as an integral part of the healing adaptation theory^{9,10}—approaches that cite and emphasize diverse aspects that impact a patient’s healing response such as considerations first identified and described in 1981.¹¹ They underscore the most likely determinants of biologic failure of osseointegration—a compelling topic deserving more study than a limited and exclusive focus on marginal changes that are presumed to mainly, or even exclusively, relate to a periodontal-like infection.

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*The five implant manufacturers who funded this meeting were Straumann (Switzerland), Nobel Biocare (Switzerland), Astra Tech (Sweden), Biomet 3i (USA), and Dentsply (Germany).

The study group's collective analysis of published data plus evaluations of personal clinical experiences informed the following conclusions:

- The great majority of well-documented oral implants show very good long-term clinical results.
- A limited amount of crestal or marginal bone loss (CBL or MBL) may be a biologic response to implant placement.
- CBL may occur for reasons other than infection.
- CBL may occur around implants and can have a long-term impact on the outcome of those implants.
- Some implants can demonstrate substantial bone loss, but a steady state may be reached and no further clinically significant bone loss observed.
- There is an adaptive change of the crestal bone level after placement and restoration.
- *Peri-implantitis* is an unsuitable term to describe all CBL.
- The term *peri-implantitis* is here defined as infection with suppuration associated with clinically significant progressing CBL after the adaptive phase.
- In contrast, *peri-implant mucositis* is defined as inflammation of the peri-implant mucosa without discernibly progressing CBL.
- Bone remodeling including CBL is influenced by inflammation.
- Implant-, clinician-, and patient-related factors as well as foreign body reactions may contribute to CBL. Implant factors: material, surface properties, and design (eg, ease of plaque removal); clinician factors: surgical and prosthodontic experience, skills, and ethics; patient factors: systemic disease and medication, oral disease (eg, untreated or refractory periodontal disease, local infections), behavior (eg, patient compliance with oral hygiene and maintenance, smoking), and site-related factors (eg, bone volume and density, soft tissue quality); and foreign body reactions (eg, corrosion byproducts, excess cement in soft tissues).
- A radiograph does not give an absolutely accurate picture of the bone-implant contact or the crestal bone situation. However, the periapical radiograph is an important clinical tool to be used at implant placement, implant loading, and repeatedly thereafter.
- Radiographs taken longitudinally may assist the clinician to monitor changes in crestal bone levels.
- Peri-implant examinations that include bleeding on probing and probing depths do not by themselves function as indicators of CBL around oral implants.
- The presence of purulent exudate in combination with clinically significant progressing CBL necessitates therapeutic intervention.
- Established dental implant therapies used today are successful with high predictability. However, implant outcomes may be at risk due to a number of factors including patient behavior, clinician expertise, and the amount of follow-up care. The prevalence of implant success is calculated in general populations of patients that are treated and evaluated under specific and sometimes stringent conditions. These evaluations depend upon a large number of variables including patient follow-up and examination over long periods of time. For these reasons, the percentage of success in the populations may vary widely. In the case of individual patients, a comprehensive examination is required that allows evaluation of the risks for their specific situation. Therefore, the outcome for the individual may be different from the outcomes calculated for large populations.
- When oral implants are placed and restored according to current established protocols, an implant success rate above 95% over 10 years has been reported in numerous recent studies. The incidence for peri-implantitis or implant failure is less than 5% under such conditions.
- In the presence of significant patient-related risk factors or suboptimal clinical performance, lower implant success rates may be encountered.
- Based upon the history and development of implant therapy, excellent clinical outcomes can be expected to continue.

References

1. Roos-Jansåker AM, Renvert H, Lindahl C, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part III: Factors associated with peri-implant lesions. *J Clin Periodontol* 2006; 33:296–301.
2. Fransson C, Lekholm U, Jemt T, Berglundh T. Prevalence of subjects with progressive bone loss at implants. *Clin Oral Implants Res* 2005;16:440–446.
3. Fransson C, Wennström J, Berglundh T. Clinical characteristics at implants with a history of progressive bone loss. *Clin Oral Implants Res* 2008;19:142–147.
4. Koldslund O C, Scheie AA, Aas AM. Prevalence of peri-implantitis related to the severity of the disease with different degrees of bone loss. *J Periodontol* 2010;81:231–238.
5. Zitzmann NU, Berglundh T. Definition and prevalence of peri-implant diseases. *J Clin Periodontol* 2009;35(suppl):286–291.
6. Lindhe J, Meyle J. Peri-implant diseases: Consensus Report of the Sixth European Workshop on Periodontology. *J Clin Periodontol* 2008;35(suppl):282–285.
7. Balshe AA, Assad DA, Eckert SE, Koka S, Weaver AL. A retrospective study of the survival of smooth- and rough-surface dental implants. *Int J Oral Maxillofac Implants* 2009; 24:1113–1118.
8. Balshe AA, Eckert SE, Koka S, Assad DA, Weaver AL. The effects of smoking on the survival of smooth- and rough-surface dental implants. *Int J Oral Maxillofac Implants* 2008;23: 1117–1122.
9. Koka S, Zarb G. On osseointegration: The healing adaptation principle in the context of osseosufficiency, osseoseparation, and dental implant failure. *Int J Prosthodont* 2012;25:48–52.
10. Chvartzsaid D, Koka S, Zarb G. Osseointegration failure. In: Zarb G, Albrektsson T, Eckert S, Stanford C, Tarnow D, Wennerberg A (eds). *Osseointegration;209;On Continuing Synergies in Surgery, Prosthodontics, Biomaterials*. Chicago: Quintessence, 2008:157–164.
11. Albrektsson T, Brånemark PI, Hansson HA, Lindström J. Osseointegrated titanium implants. Requirements for ensuring a long-lasting direct bone-to-implant anchorage in man. *Acta Orthop Scand* 1981;52:155–170

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