

Experts seek keys to marginal bone maintenance

Daniel van Steenberghe

The long-term survival of endosseous intra-oral implants has become a public health issue in recent years inasmuch as tens of millions of patients now have one or more of these implants. To ensure implant survival and restorative longevity, the maintenance of marginal bone around these implants is a significant element of treatment and consequently should be the subject of conscientious scientific follow-up. Progressive bone loss may lead to insufficient anchorage, significant infections and even the loss of the implant, after all.

In order to address the issue of bone maintenance in a scientific and clinically documented manner, Nobel Biocare proposed that an international group of experts be assembled last year, and asked me to moderate the group. Our brief: to thoroughly review the current state of knowledge in this area, and to propose how to proceed in the future. Thus the Working Group on "Treatment options for the maintenance of marginal bone around endosseous oral implants" was born.

Given free hands to select whomever I deemed most appropriate, invitations to join the Working Group were sent out on the basis of the invitees' publication and citation records. Because the group ultimately would be making both scientific and clinical recommendations, it was important to find authorities in a wide range of disciplines, each directly germane to the issue of marginal bone maintenance.

Eight independent scientists and clinicians joined the Working Group from the very beginning, and have made valuable contributions ever since: Marco Esposito (UK), Björn Klinge (SE), Joerg Meyle (DE), Andrea Mombelli (CH), Eric Rompen (BE), Tom Van Dyke (US), Hom-Lay Wang (US) and Arie-Jan van Winkelhoff (NL).

All of these renowned authorities joined the group under the proviso that they would be willing to participate on an



Members of the working group from the Karolinska Institutet on stage at Europerio, June 8, 2012. Pictured from left: Drs. Marco Esposito (UK), Hom-Lay Wang (USA), Thomas E. Van Dyke (USA), Andrea Mombelli (CH), Daniel van Steenberghe (BE), Arie Jan van Winkelhoff (NL), Björn Klinge (SE) and Eric Rompen (BE). Not pictured: Dr. Joerg Meyle (DE).

independent, pro bono basis. For several months last year, they reviewed the literature on marginal bone from the perspective of their own fields of study, which include investigational methodology, oral and maxillofacial surgery, periodontology, immunology, biomaterials, oral physiopathology, oral rehabilitation and microbiology.

After exchanging their review papers, the members of the group met in September for two days at the Karolinska Institutet in Stockholm, where the Nobel Assembly chooses the prestigious Nobel Prize laureate in Physiology or Medicine each year. Björn Klinge served as host.

Nobel Biocare has very generously covered the Working Group's travel expenses in good faith since its inception, and done so without intervening in any way in the discussions or demanding a quid pro quo of any sort. The company also provided a subsequent public discussion forum for the group at the Europerio 7 meetings in Vienna this June.

Revised review papers, consensus statements and clinical guidelines were published in their entirety in the interim between these two meetings in a single-topic supplement

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to the "European Journal of Oral Implantology" (2012, 1 supplement: 1 - 106).

Key causes of marginal bone loss addressed

The group identified a series of possible causes of marginal bone loss. These can be divided into two groups: those playing a role soon after implant insertion and those occurring at a (much) later stage.

Among the causes leading to marginal bone resorption soon after implant placement, surgical trauma (either by overheating or undue compression of the surrounding bone) is well documented. As Per-Ingvar Brånemark learned in his early studies of osseointegration, in order to prevent such unintended trauma, it is of the utmost importance to treat bone as a living tissue.

Other causes of resorption are less well documented, but are represented in the scientific literature nevertheless, and hardly in doubt. To give three examples: When implants are placed in jawbone with very limited bone volume, dehiscences often result, which leads to proximal bone resorption; although reluctantly reported, subgingival cement remnants generally result in substantial bone resorption; and too-deep placement of an implant can also provoke marginal bone loss.

At a later stage, several weeks or months after prosthesis installation, occlusal overload has been recognized as another potential cause of marginal bone loss. In situations like these, occlusal adjustments or other biomechanical interventions are called for to stabilize the bone.

Nowadays, a proclivity for optimizing esthetics – or even cosmetics – sometimes leads to repeated removal of the abutment. These disruptions of the connective tissue seal can result in bone loss.

The same applies to insufficient biological width. The colonization of the implant surfaces by bacterial biofilms has been associated with chronic inflammation of the marginal tissues and subsequent bone loss. A proper oral hygiene regimen is the appropriate response in circumstances such as these. Corrosion at the implant/abutment surface is scarcely documented, yet it remains another suspected cause of bone resorption.

Steps to be taken

Since all these etiological factors can be fostered by systemic or local pathologies, the Working Group proposes a comprehensive multidisciplinary treatment plan involving sanitation of the entire oropharyngeal cavity as a preventive measure. Prior to surgery, any smoking and/or parafunctional habits must be dealt with.

To maintain marginal bone in a long-term perspective, oral

hygiene, especially in patients susceptible to periodontal inflammation, should be monitored.

Even though much roughened implant surfaces (such as the plasma-sprayed surfaces, which have more-or-less been abandoned) may promote the prevalence of peri-implantitis, there are insufficient data to identify which other implant surfaces, if any, may be associated with the loss of marginal bone. The sample size of the one single study on experimental peri-implantitis in dogs – which attempted to approach this issue from a laboratory point-of-view – has to be considered too small to draw any valid conclusions.

Methodological issues yet to be resolved

The prevalence of peri-implantitis depends on the cut-off value used to define when progressive marginal bone loss should be deemed pathologic. Defining the parameter at 2 mm, for example, instead of 3 mm, dramatically shifts statistical outcomes.

With commercial implant systems currently available, the prevalence of peri-implantitis varies between 5 and 20 % at the patient level, while at the individual implant level it is below 5 % even after 10 years. Smoking, it should be noted, dramatically affects the rate at which peri-implantitis occurs. In a recent study, the occurrence of peri-implantitis among smokers with a history of periodontitis was, at the patient level, >50 % as opposed to <3 % for non-smokers; and no peri-implant disease was diagnosed in non-smoking patients who had no periodontal history and demonstrated good compliance after treatment.

Choice of a common baseline

A variety of different baselines are currently being used in studies of marginal bone-loss, which makes comparisons difficult, if not impossible. The choice of which baseline to use is a significant methodological issue. Marginal bone loss, occurring during the healing phase soon after implant placement, should be distinguished from that occurring at a later stage.

The Working Group urges the authors of future studies (i.e. clinical trials) on immediate loading to use radiographs taken at least 3 months after implant placement as a baseline for the subsequent study of marginal bone loss. Otherwise, comparisons to delayed-loading reports, where the baseline bone level is usually established at the time of prosthesis installation, (ordinarily several months after implant placement), will remain unfeasible.

Marginal bone loss can lead to the deepening of periodontal pockets, which subsequently get infected by periodontal pathogens. Thus peri-implant disease, as it is currently being described, can be a consequence of marginal

bone loss initiated by a wide variety of causative factors (see the potential causes described above). From a clinical perspective, dealing with the appropriate etiology in every case is, of course, of paramount importance.

Treatment

For the treatment of peri-implantitis, the Working Group's consensus is to encourage open-flap surgery to decontaminate the implant surface. To achieve this decontamination, many different protocols have been documented: rinsing with saline, mechanical debridement and Er:YAG laser therapy. They all seem equally effective. Subgingival slow-release devices with antimicrobials of the tetracycline group, used as an adjunct to mechanical debridement, may arrest peri-implantitis. On the other hand, there is no conclusive proof of the benefit of systemic antibiotic therapy.

It should be noted that, no matter the treatment modality chosen, the majority of peri-implantitis lesions are not resolved by the undertaken treatment.

What's next?

The Working Group proposes clinical guidelines based on the vast, multidisciplinary literature review its members have carried out. The therapeutic approaches proposed are all based on sound scientific data, rather than limited observations or anecdotal reports, and have been published – as previously noted – in the “European Journal of Oral Implantology” (2012, 1 supplement: 1 - 106).

Comprehensive patient care must include both preventive measures and steps to assure good maintenance.

For some implant types, stable marginal bone levels have been reported for ten years and more. While this is very good news, reporting only mean-bone-level values may ignore clinically relevant outliers, should they exist.

Much work remains to be done. Prospective randomized controlled trials are urgently needed to further identify the prevalence and relative preponderance of the different causes of marginal bone loss and how best to deal with them. This is a field worthy of much more clinical and scientific study.



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