

The 1st Baltic Osseointegration Academy and Lithuanian University of Health Sciences Consensus Conference 2016. Summary and Consensus Statements: Group I - Peri-Implantitis Aetiology, Risk Factors and Pathogenesis

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ABSTRACT

Introduction: The task of Group I was to review and update the existing data concerning aetiology, risk factors and pathogenesis of peri-implantitis. Previous history of periodontitis, poor oral hygiene, smoking and presence of general diseases have been considered among the aetiological risk factors for the onset of peri-implant pathologies, while late dental implant failures are commonly associated with peri-implantitis and/or with the application of incorrect biomechanical forces. Special interest was paid to the bone cells dynamics as part of the pathogenesis of peri-implantitis.

Material and Methods: The main areas indagated by this group were as follows: influence of smoking, history of periodontitis and general diseases on peri-implantitis development, bio-mechanics of implant loading and its influence on peri-implant bone and cellular dynamics related to the pathogenesis of peri-implantitis. The systematic reviews and/or meta-analyses were registered in PROSPERO, an international prospective register of systematic reviews: <http://www.crd.york.ac.uk/PROSPERO/>. The literature in the corresponding areas of interest was screened and reported following the PRISMA (Preferred Reporting Item for Systematic Review and Meta-Analysis) Statement. Method of preparation of the systematic reviews, based on comprehensive search strategies, was discussed and standardized. The summary of the materials and methods employed by the authors in preparing the systematic reviews and/or meta-analyses is presented in Preface chapter.

Results: The results and conclusions of the review process are presented in the respective papers. One systematic review with meta-analysis, three systematic reviews and one theoretical analysis were performed. The group's general commentaries, consensus statements, clinical recommendations and implications for research are presented in this article.

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RESULTS

The following reviews were prepared for publication as a result of work of Group 1:

1. Influence of Peri-implant Soft Tissue Condition and Plaque Accumulation on Peri-implantitis: a Systematic Review (Pranskunas et al. [1])

General commentaries

A sufficient amount of keratinised tissue has been traditionally recognised as an important factor to maintain periodontal health and to prevent soft tissue recession. Particularly, it has been believed that the success of implants is dependent on the ability of the peri-implant mucosa to perform the role of protective biological barrier between the oral environment and the implants.

The absence of adequate keratinised mucosa (KM) around endosseous dental implants, especially in posterior areas, is associated with higher plaque accumulation and gingival inflammation. In fact, good oral hygiene around dental restorations becomes problematic for the patient, without the protection of a band of keratinised gingival tissue. Therefore, in order to achieve long-term stable peri-implant health, it is important to obtain and maintain an adequate soft tissue seal around implant-supported restorations.

Due to marked heterogeneity among the included studies in terms of design, quality of reported data and varying outcomes, no meta-analysis could be performed. No final recommendations can be suggested for individual clinical cases.

Consensus statement

Width of KM around dental implants appeared to be related with less mucosal inflammation, less plaque accumulation, increased stability of the peri-implant area and prevention of mucosal recession. However, inadequate (< 2 mm) width of KM could not be related with lower dental implant survival rates. Easy access for oral hygiene at dental implant sites also appeared as an important factor to maintain implant health.

Clinical recommendations

- It is important to preserve existing keratinised tissue around dental implants during the treatment procedures;
- Soft tissue grafts can be recommended to allow a more effective plaque control, facilitate impression

procedures and dissipate muscular and frenal pulls, possibly preventing further recessions.

Implications for research

Further long-term studies are needed to determine the clinical significance of the presence of keratinised tissue around dental implants, analysing biological, surgical and prosthetic outcome variables. It is necessary to standardise studies design, with patient recruitment based on rigorous inclusion/exclusion criteria and with an accurate control of the confounding factors.

Three investigation groups could be recommended: sites with “adequate” (≥ 2 mm), “inadequate” (< 2 mm) and “absent” (0) keratinised mucosa.

Moreover, it is recommended to investigate possible differences between implants placed in upper and lower jaw and between edentulous and partially edentulous patients.

2. Risk Factors for Peri-Implantitis: Effect of History of Periodontal Disease and Smoking Habits. A Systematic Review and Meta-Analysis (Stacchi et al. [2])

General commentaries

History of periodontal disease and smoking habits have often been identified as conditions favouring the onset of peri-implant pathologies. Even if several longitudinal studies have been conducted on these issues, showing some evidence of a negative impact on implant outcomes, recent reviews did not draw definitive conclusions. The present systematic review highlighted general limitations in the available literature on this topic: all studies were based on convenience samples (mostly of limited size), different diagnostic criteria for peri-implantitis and periodontal disease were adopted, and potential confounders (e.g. systemic conditions, age, sex, bone quality, implant features, type of prosthesis, parafunctions) were only partially reported and seldom assessed during outcomes analysis. Hence, the results of our meta-analysis should be considered with great caution and should be interpreted only as a tendency, until sound epidemiological studies will confirm or reject them.

Consensus statement

There is weak evidence suggesting that history of periodontitis could represent a risk factor for the onset of peri-implantitis. There are not sufficient data

available to clarify the influence of smoking habits in favouring peri-implant pathologies.

Clinical recommendations

Patients should be aware about the risk factors influencing long-term outcomes of dental implants when they decide to undergo this kind of therapy. Data from this systematic review indicated that history of periodontitis could be a favouring factor for the occurrence of peri-implantitis, but without resulting as a significant risk factor for implant loss. No conclusions could be drawn for the influence of smoking habits on implant outcomes. According to the low number and the substantial limitations of the included studies for both the analysed issues, the available evidence, when present, is weak. Therefore, no specific clinical recommendation can be made for the management of periodontal patients and smokers. On the basis of the results of this review, it has only been agreed that:

- Patient should be informed that biological response of peri-implant tissues could be influenced by a history of periodontal disease, favouring the onset of peri-implant pathologies, which could jeopardise implants longevity;
- An accurate control of the other potential risk factors for peri-implantitis and a comprehensive implant maintenance program is particularly recommended in these patients.

Implications for research

There is an absolute need for improving the quality of the epidemiological studies on these topics. Reaching a general consensus among the scientific community for the definition of peri-implantitis and related diagnostic criteria might be the first step. Then, it is necessary to design robust long-term longitudinal studies, with an accurate sample selection and stratification, together with a strict control of the various confounders, in order to evaluate the real impact of the single risk factors on the onset of the disease.

3. The Prosthetic Influence and Biomechanics on Peri-Implant Strain: a Systematic Literature Review of Finite Element Studies (Maminskas et al. [3])

General Commentaries

Based on Frost mechanostat theory, bone physiology is closely related to mechanical influence of loading. Functional loading is necessary for bone health,

acting as a positive stimulus for bone metabolism within two limits: the first is the lower boundary of stress which can stimulate bone vitality, the second is the higher stress which can be tolerated without bone resorption. Osseointegrated dental implants should also work between these two boundaries and overloading could result in peri-implant bone loss. Many studies evaluated bone loss caused by bacterial inflammation, but few of them are focused on stress-related factors. Moreover, the more recent studies are based on finite element analysis (FEA), and they are able to provide a realistic simulation of load distribution and stress measurements at peri-implant bone. Unfortunately, there is no methodological homogeneity, leading to heterogeneity of results. Moreover, some *in vivo* researches suggested correlations between FEA findings and clinical outcomes, but these results should be confirmed on a larger scale by appropriate studies.

Consensus statement

Non-axial loading, cantilever prosthetic elements, crown/implant ratio, type of implant-abutment connection, misfits, properties of restoration materials and antagonistic tooth could affect peri-implant bone.

Clinical recommendations

- It is recommended to use platform switching implant-abutment connections;
- In order to reduce stress at peri-implant cortical bone, it is recommended to position the implant along the chewing direction, avoiding when possible angled abutments;
- Short implants could create higher stress at peri-implant cortical bone, therefore it seems rational to maintain a crown/implant ratio never smaller than 2.5;
- Underline the concept of passive fit in order to avoid micro-strains;
- Use shock-adsorbing materials on dental implants;
- Plan correct implant position considering natural antagonistic teeth in case of partially edentulous patients.

Implications for research

Studies based on FEA are the most frequent in literature when considering the loading forces distribution at implant-bone interface. FEA is a useful digital tool for tendency observations, but partly unrealistic in comparison with clinical reality.

- Long-term well designed clinical trials evaluating

the influence of loading on peri-implant bone interface are necessary;

- It is important to define the safety limits of the chewing forces, beyond which fatal stress could develop, potentially jeopardising osseointegration;
- Indagate the fields in which the clinical treatment is not evidence based;
- Compare in clinical trials not only restorative materials but also implant systems.

3. General Diseases Influence on Peri-Implantitis Development: a Systematic Review (Guobis et al. [4])

General commentaries

The scientific evidence about the influence of systemic diseases on implant therapy is weak. There are many systemic conditions that could be listed as potential risk factors, but further confirmations by appropriate trials are needed. The screened literature is composed only by case series studies with short follow-up periods, with a pool of patients that is considered controversial. We found no consistent data on disease activity and medications intake or detailed risk factor analyses of patients with peri-implant pathologies. There is a tendency of very positive results in various systemic conditions that should be interpreted with caution and criticism. Surgeon should consider how long the systemic disease could be maintained stable before being finally treated or become uncontrolled.

Consensus statement

There is weak evidence and high controversy about the potential effect of various systemic diseases on the success of dental implants. Therefore, even if the complications rate seems low in short term follow-up, long term prognosis needs to be verified.

Clinical recommendations

- Based on published literature it is not possible to distinguish between subtypes of diseases: diabetes (type I vs type II), osteoporosis (bone mineral density [BMD], central dual-energy X-ray absorptiometry [DXA] tests), rheumatoid arthritis;
- In various studies, implant therapy in diabetes mellitus patients, even in those with poorly controlled disease, had been presented as highly successful;
- However the diabetic patient, who should be compensated before the implantation procedure, is at great risk for periodontitis;

- The higher risk failure of implants in diabetic patients was mentioned in all the studies, despite the positive outcomes;
- A weak relationship between bone density in osteoporosis and implant failure was demonstrated in two studies with long follow-up and a big cohort;
- Further studies are needed to evaluate the effects of glycaemic control on dental implant success and on the effects of oral bisphosphonates over time on patients who have undergone implant therapy;
- No significant correlations were demonstrated between rheumatoid arthritis, oral lichen planus and implant success rates;
- Short-term success of implants in HIV-positive individuals was demonstrated in pilot studies;
- Bone response around submerged dental implants in immunocompromised organ transplanted patients does not differ from the response in control patients;
- Caution should be used for implants in Sjögren's patients, as there is some evidence of potentially increased risk of peri-implantitis in the long term period.

Implications for research

Long term follow-up randomised controlled studies with homogeneous diagnostic criteria and standardised protocol of implantation for patients with systemic diseases, considering bone quantity/quality, soft tissue morphology, implant type, disease history and activity, pharmacological therapy, peri-implantitis data, history of periodontitis, lifestyle related risk factors, oral hygiene habits and prosthetic features. Investigate the effect of combination of systemic diseases and multiple independent factors on the peri-implantitis development.

Finally, it would be important to analyse the success rate of different types of bone augmentation procedures in patients with systemic diseases: a possibly different healing response related with local risk factors influenced by the systemic disease could be a crucial issue. Implants are an elective treatment and risk/benefit analysis should be performed for every patient when planning therapy.

4. Bone Cells Dynamics during Peri-Implantitis: a Theoretical Analysis (Fernandes and Gomes [5])

General commentaries

In peri-implantitis, the local immune-inflammatory process is associated with a disturbed bone

tissue metabolism and remodelling. Induced osteoclastogenesis and osteoclast function appear to be central determinants in the disengaged bone resorption/bone formation equilibrium, converging to the verified loss of the supporting alveolar bone and consequent implant failure. This process seems to be greatly regulated by the RANKL/RANK/OPG system, in which both stromal/osteoblastic and immune-inflammatory cells act, either directly or indirectly. Furthermore, disturbed functioning of osteoblasts, reflected by the possible expression of a fibro-osteoblastic phenotype secreting increased fibrocystic markers may also contribute to the verified imbalances.

Consensus statement

The knowledge of the cellular interplay and molecular mechanisms underlying bone tissue loss in peri-implantitis is scarce. Clinical relevant data are limited to the acquaintance of a few altered classical inflammatory and bone metabolic markers determined within the peri-implant crevicular fluid. The detailed understanding of the molecular and cellular interplay

dynamics in peri-implantitis is determinant for the developing of innovative therapeutic options for peri-implantitis modulation.

Implications for research

Due to the complexity of the events associated to peri-implantitis, a “bottom-up” approach is envisaged, i.e. a fundamental level of research, focusing on the cellular and humoral crosstalk, either regarding bone cells and those involved within the immune-inflammatory activation, in the context of an integrated view of the osteoimmunologic interplay occurring in the peri-implantitis environment.

DISCLOSURE STATEMENTS

All group members were asked to sign a Panel Member Agreement (PMA). This agreement requires individuals to maintain the highest level of integrity and avoid all actual, perceived, and potential conflicts of interest. All the authors reported no conflicts of interest related to this study.

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