

Local risk indicators – Consensus report of working group 2

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In implant dentistry, plaque control and oral hygiene practices are essential to limit the risk of complication and failure in the long term. All conditions around an implant in function that influence the load and pathogenicity of the microbiota are considered local risk indicators. They concern the prosthetic suprastructure design and the possibility for the patient to easily access each implant for plaque removal. Use of cemented prostheses should be limited to avoid excess cement acting as a foreign body and leading to peri-implant disease. The crown margins should be supramucosal, and the connection should be precise to avoid a gap between the implant and the suprastructure. Every implant system is characterised by a specific design, surface texture and connection type. These features may influence peri-implantitis development and progression, and the clinician should consider the risk of infection when selecting an implant. The soft-tissue conditions around the implant, the width of keratinised mucosa, and the phenotype and thickness of the mucosa are also considered major risk indicators, as the presence of any mucosal defect around an implant can increase plaque accumulation and result in tissue inflammation. The pathogenicity of the microbiota around an implant is primarily dependent on pocket depth. Deep pockets around implants should be avoided and, if present, closely monitored and/or reduced. Proximity to natural teeth presenting endodontic and/or periodontal lesions may result in implant contamination, but the influence of the type of edentulism on perio-pathogen presence is still unclear. These local conditions around an implant have a clear influence on peri-implant diseases development and progression, but there is still only limited evidence regarding their role as true risk indicators.

Key words: Peri-implant diseases, peri-implantitis, peri-implant mucositis, pathogenesis, risk indicators, local conditions

INTRODUCTION

Peri-implantitis, like periodontitis, is an inflammatory disease due to infection and has a multifactorial aetiology. Conditions that are associated with the development of peri-implantitis are known as risk indicators. These risk indicators can be either general or local. General risk indicators may influence the patient's susceptibility to infection, whereas local risk indicators influence the bacterial load and the bacterial pathogenicity around implants. Local risk indicators include all the specific conditions around each implant, such as prosthetic options, the implant system, the soft tissue conditions, and the peri-implant microbiome.

The following consensus report is based on the review papers prepared and discussed during the FDI

Workshop held in May 2018^{1,2}. Several questions about local risk indicators and their impact on the development and progression of peri-implant diseases were addressed by Working Group 2. Of the four intended papers from Working Group 2, only two were submitted for publication. The first review paper by Lin & Madi reported limited evidence to correlate peri-implant soft-tissue parameters to peri-implantitis¹. However, an adequate amount of mucosal height will theoretically ensure the biological width around the implant. In the absence of a wide band of keratinised tissue, adequate oral hygiene regimes were identified as sufficient to prevent mucositis. The second literature review conducted by Serino & Hultin summarises prosthetic risk factors affecting the incidence, prevalence and treatment outcomes of peri-implant disease².

Residual cement about implant abutments was identified as a risk factor for mucositis and peri-implantitis. Additionally, screw-retained implants where the prosthesis screws directly to the implant have a higher risk for peri-implant disease. The topics and questions addressed by the two unsubmitted papers were also discussed during the workshop and are reflected in this consensus paper.

Through this process the working group has conducted an in-depth review of the literature, indicating that the number of studies and level of evidence on this subject is still very low. We can, however, analyse the available data to better understand the influence of local conditions around implants on the development and progression of peri-implant diseases. This exercise has allowed concrete responses to be developed to relevant questions on the subject, and above all to express practical recommendations to improve the prevention of peri-implantitis.

SUMMARY STATEMENTS IN THE AREAS OF LOCAL RISK INDICATORS, AS DEVELOPED BY WORKING GROUP 2 DURING THE FDI CONSENSUS MEETING

Prosthetic options

Prosthetic suprastructures are designed with different options regarding the mode of retention, connection, positioning of the crown margin and emergence profile of the prosthesis. Increasingly, clinicians are cementing the prosthesis onto the implant abutments. This has implications for implant care, however, as removing the suprastructure is beneficial for the prevention and treatment of peri-implant infections. While it is possible to remove the suprastructure in screw-retained prostheses, it is not possible to do so for cemented prostheses.

Excess cement present in the sulcus acts as a foreign body and induces an inflammatory reaction, leading to the loss of supporting bone³. The implant connection should ensure good stability and seal, as a gap between the implant and the suprastructure offers an ideal environment for microbial colonisation. Therefore, it is always beneficial to use a machined abutment rather than a 'direct implant' technique.

To optimise aesthetic outcomes, it is common to place the border of the prosthesis under the mucosal margin. However, to facilitate oral hygiene procedures, especially in the posterior areas, the abutment-prosthesis interface should be supramucosal.

The shape of the prosthetic reconstruction should facilitate proper plaque control⁴. If the patient cannot clean around each implant, infection will occur. The prosthetic reconstruction should therefore be designed to facilitate plaque removal around the implant.

Does the mode of retention have an influence on either peri-implant mucositis or peri-implantitis?

Cement excess has been reported as highly associated with peri-implant mucositis and peri-implantitis. Screw-retained reconstructions should be favoured whenever there is a risk of excess cement not being entirely removed. The use of screw-retained restorations makes prosthesis retrievability easier when managing biological complications.

Is it beneficial to use an abutment as opposed to a direct implant connection?

One-piece prostheses directly screwed onto the implant have a higher risk of developing peri-implantitis compared with prostheses on machined abutments.

What are the risks of positioning the crown margin below the mucosa level?

The deeper the crown margin, the higher the risk of creating a deep pocket. The appropriate abutment should be selected in order to avoid placing sub-mucosal crown margins close to the bone crest, both in screwed and cemented prostheses.

What is the optimal prosthetic profile for reconstructions to facilitate proper plaque control?

The emergence profile should avoid over-contours and allow 360° access for diagnostic and oral hygiene instruments. Concave profiles should be used with great caution.

Implant systems

The implant design, connection type, surface characteristics and specificity of the transmucosal part are all characteristics of implant systems.

An implant can be conical or cylindrical. It can be designed as one-piece for non-submerged healing ('tissue-level' implant), or two-pieces for submerged healing ('bone-level' implant). The effect of these features on peri-implant infections has been debated for many years, but there are still very few comparative studies available.

Concerning implant surface texture, rough surfaces appear to fail more often and to be associated with an increased incidence of peri-implantitis compared with moderately rough or machined surfaces. Providing that microorganisms do not colonise a surface, the surface texture is unlikely to be of importance. However, exposure of rough surfaces facilitates plaque retention and influences the progression of peri-implant disease⁵.

The type of connection may also influence peri-implant health, and it appears that pocket depth at implants is deeper with external connection types compared with those with internal connections⁶. This difference can be explained by mechanical stability, which appears to be better with internal connections.

For one-piece implants, the height of the transmucosal portion may vary. For two-piece implants, a smooth col with a minimum height is necessary to favour soft-tissue attachment and respect biological width. For 'bone-level' implants, the impact of the nature of the abutment surface attachment is less clear.

Does the implant design influence the risk of peri-implantitis?

There is limited evidence that rough-surface implants have a higher incidence of peri-implantitis compared with moderate and minimally-rough surfaces.

Do surface characteristics have an impact on the development and/or progression of peri-implantitis?

There is limited evidence that rough-surface implants have a higher incidence of peri-implantitis compared with moderate and minimally-rough surfaces.

Is there a connection type (external vs. internal connection) proven to decrease the risk of peri-implantitis?

There is no evidence that connection type has an impact on the risk of developing peri-implantitis.

What is the suggested minimal distance between the bone crest and the prosthetic margin?

There is limited evidence that peri-implantitis risk is higher if the distance between the crown restoration margin and the bone crest is less than 1.5 mm.

Soft-tissue conditions

The soft-tissue conditions around implants include the width of keratinised mucosa, the height of crestal mucosa, the phenotype and the presence of recession.

The nature of soft tissue and the presence of a minimal width of keratinised mucosa may influence peri-implant health⁷. The presence of soft-tissue defects, such as a lack of vestibule depth, the presence of scar tissue formation, frenulum traction or soft-tissue margin mobility, induces more plaque accumulation, tissue inflammation, attachment loss and recession.

The thickness of the soft tissue around implants is determined by the height of the crestal mucosa and

may influence the risk of peri-implantitis⁸. A minimal mucosa thickness is necessary to favour the soft tissue attachment with respect to the biological width.

Soft-tissue phenotype is an important parameter to consider for aesthetic implant restorations in order to improve immediate implant success and prevent future mucosal recession. The stability of the marginal mucosa is not only dependent on the nature of peri-implant soft tissue but also on the underlying bone. The presence of a bone dehiscence may increase the risk of mucosal recession. The presence of soft-tissue recession may increase the risk of peri-implantitis, particularly if a rough portion of the implant surface is exposed.

What are the common problems associated with lack of keratinised mucosa (width)?

There is evidence that the absence of keratinised, non-mobile mucosa (width) increases plaque accumulation, tissue inflammation, recession and loss of attachment. Its effect can be aggravated by shallow vestibules.

What is the suggested crestal mucosa height around dental implants to reduce the risk of peri-implantitis?

There is insufficient evidence that a minimum mucosa height is needed around dental implants.

What is the impact of phenotype on long-term peri-implant tissue stability?

There is no evidence that tissue phenotype influences the development of peri-implantitis, even though the risk of recession may be higher for thin phenotypes.

When is soft-tissue recession a risk for peri-implantitis progression?

When a rough surface of the implant is exposed to the oral cavity, bacterial adhesion increases.

The peri-implant microbiome

The local conditions around implants may influence the load and pathogenicity of the surrounding microbiota. These conditions include the peri-implant pocket depth, the endodontic and periodontal status of proximal natural teeth and the type of edentulism.

Pocket depth about implants influences the nature of the microbiome; consequently, the presence of deep pockets may represent a risk for disease development⁹. For aesthetic reasons, implants in the maxillary anterior region are often placed too apically. This creates an initial deep pocket that may be more susceptible to future disease development. An implant surface

can also be contaminated by endodontic lesions at adjacent teeth. The distance between endodontically treated teeth and the implant, as well as the time between endodontic treatment and implant placement, is debated but it seems obvious that placing implants in areas with infected teeth should be avoided.

In partially edentulous patients, the periodontal status of the remaining teeth influences the composition of the subgingival microflora around implants, as teeth with periodontal disease may act as a reservoir for microorganisms to colonise the implant. Therefore, infected teeth that have been considered unreasonable to treat should be extracted as part of overall infection control measures. Periodontal pockets deeper than 4 mm should be eliminated before implant placement.

In periodontally involved patients, disease control and stability should be obtained prior to implant placement, by appropriate therapy and supportive care.

The type of edentulism may influence the presence of perio-pathogens. In partially- and fully edentulous patients, the presence of pathogens is the same, except for *Agregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis*¹⁰. Full-mouth extractions do not eliminate the periopathogens. Periopathogens may remain for a long period of time in the oral cavity of edentulous patients with a history of periodontitis.

Is there a correlation between pocket depth and the microbiome?

A greater number of bacteria and pathogenic bacteria are found at sites with deeper probing depths.

How should implant placement be performed in the presence of endodontic lesions?

It is recommended to maintain a minimal distance from the apex of an endodontically treated tooth and wait for healing (>4 weeks) before placing an implant next to an endodontically treated tooth.

What is the risk of implant placement in the presence of periodontal lesions?

In periodontally involved patients, successful periodontal treatment should be performed before implant therapy, and appropriate supportive periodontal care should be ensured.

Does the extent of tooth loss (partial vs. full) influence the presence of periodontal pathogens?

In fully edentulous patients, periodontal pathogens may remain in the oral cavity for an extended

period (up to 1 year), even after full-mouth tooth extraction.

CONCLUSIONS

Currently, there is limited evidence that the above-listed factors are significant risk indicators for peri-implantitis. Nevertheless, in implant dentistry, the clinician should be aware of these factors in order to reduce the incidence and progression of biological complications. For each indication, they should adapt the technique of implant placement to the local conditions. They should select the method, the implant and its components to limit the infectious risk and achieve the appropriate prosthetic suprastructure.

From this analysis, we can express some practical recommendations.

- Screw-retained prostheses should be favoured to facilitate the management of complications and to limit the risk of excess cement.
- The presence of a gap should be avoided, and the use of a machined abutment should be favoured over a 'direct implant' technique.
- The crown margin should be positioned above the mucosa.
- The prosthetic profile should facilitate proper plaque control and regular use of interproximal oral hygiene instruments.
- A minimum width of non-mobile keratinised mucosa should be preserved.
- Soft-tissue defects (vestibule depth, frenulum traction, scar tissue formation) should be corrected to prevent peri-implant diseases.
- Deep pockets around implants should be avoided and reduced if present.
- In partially edentulous patients, successful endodontic treatment should be performed when needed on remaining proximal teeth before implant placement.
- In periodontal patients, successful periodontal treatment should be performed before implant placement and all compromised teeth should be extracted.
- All patients should be provided with oral hygiene instructions and efficient supportive care should be performed.

Even if the implant itself, the design, the type of connection and the surface characteristics of the implant have an impact on infectious risk, there is currently no evidence to recommend a specific implant concept.

Conflict of interest

The authors have no conflicts of interest to declare.

Funding

Funding for the FDI Peri-implant Diseases Project and Consensus Workshop was provided by the International Congress of Oral Implantologists.

REFERENCES

1. Lin GH, Madi IM. Soft-tissue conditions around dental implants: a literature review. *Implant Dent* 2019 28(2): 138–143.
2. Serino G, Hultin K. Periimplant disease and prosthetic risk indicators: a literature review. *Implant Dent* 2019 28(2): 125–137.
3. Linkevicius T, Puisys A, Vindasiute E *et al.* Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. *Clin Oral Impl Res* 2013 24: 1179–1184.
4. Serino G, Ström C. Peri-implantitis in partially edentulous patients: association with inadequate plaque control. *Clin Oral Impl Res* 2009 20: 169–174.
5. Albouy JP, Abrahamsson J, Berglundh T. Spontaneous progression of experimental peri-implantitis at implants with different surface characteristics. An experimental study in dogs. *J Clin Periodontol* 2012 39: 182–187.
6. de Medeiros RA, Pellizzer EP, Vecchiato Filho AJ *et al.* Evaluation of marginal bone loss of dental implants with internal or external connections and its association with other variables: A systematic review. *J Prosthetic Dent* 2016 116: 501–506.
7. Lin GH, Chan HL, Wang HL. The significance of keratinized mucosa on implant health: a systematic review. *J Periodontol* 2013 84: 1755–1767.
8. Akcali A, Trullenque-Eriksson A, Sun C *et al.* What is the effect of soft tissue thickness on crestal bone loss around dental implants? A systematic review. *Clin Oral Impl Res* 2017 28: 1046–1053.
9. Renvert S, Roos-Jansaker AM, Lindahl C *et al.* Infection at titanium implants with and without a clinical diagnosis of inflammation. *Clin Oral Implants Res* 2007 18: 509–516.
10. Van Assche N, Van Essche M, Pauwels M *et al.* Do periopathogens disappear after full-mouth tooth extraction. *J Clin Periodontol* 2009 36: 1043–1047.

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