“All that glitters ain’t gold”
Can ceramic implants meet higher expectations?

Dr Dirk U. Duddeck, Germany

When Prince wrote his song “Gold”, of which the headline of this article quotes the refrain, he tried to explain the problem of having exaggerated expectations in a relationship. Presumably, he was not thinking about an ideal material for dental implants. Zirconium dioxide may have some advantages in comparison with titanium or titanium alloys. Better aesthetic appearance in case of significant bone loss and low plaque affinity are benefits of this material. As the production process differs from titanium implants, one might expect that the surface cleanliness of zirconia implants further makes a difference.

Implant surfaces determine the initial phase of the biological response to the inserted implant and affect its ability to integrate into the surrounding tissue. Unfortunately, the majority of dental practitioners only receive limited non-biased information about the surface quality of implants used in their daily practice. Impurities on sterile-packaged implants, in particular organic particles from the production or packaging process, are highly suspected of being responsible for incomplete osseointegration of dental implants, inducing a foreign-body reaction, leading to early peri-implantitis or even loss of bone in the initial healing period.

Four consecutive studies over a period of more than ten years, conducted in close cooperation with the University of Cologne and the Charité–University Medicine Berlin, both in Germany, have shown that neither the CE (French: Conformité Européenne) marking nor U.S. Food and Drug Administration clearance can provide a reliable indication of the cleanliness of zirconia or titanium implants. Scanning electron microscopy (SEM) imaging and elemental analysis (EDS) revealed an increas-

![Fig. 1: Mapping image of a zirconia implant (assembled from 546 SEM images at 500x, detail enlargement at 1,000x).](image)
ing number of dental implants with impurities. Intermediate results of the current Implant Study 2017–2018, performed by the CleanImplant Foundation and Charité, have given cause for concern. The study showed zirconia implants with clean surfaces, as well as others with remnants of aluminium oxide (Fig. 1) and samples with significant organic impurities (Figs. 2 & 3), thus indicating that any expectations of superior cleanliness of all zirconia implant systems may not be fulfilled.

CleanImplant, an independent non-profit organisation, carries out periodical quality assessments and is supported by a scientific advisory board. The board is chaired by renowned scientists and practitioners, such as Prof. Tomas Albrektsson (Sweden), Prof. Ann Wennerberg (Sweden), Dr Michael Norton (UK), Prof. Hugo de Bruyn (Netherlands), Prof. Florian Beuer (Germany), Dr Scott D. Ganz (US), Dr Jaafar Mouhyi (Morocco) and Dr Luigi Canullo (Italy).

The foundation established a thorough and accredited testing procedure that not only is being used for the Implant Study 2017–2018, but also builds the basis for a new, globally accepted quality seal for dental implants: the Trusted Quality Mark. All implants have to be unpacked and analysed by SEM under cleanroom conditions according to ISO Class 5 (DIN EN ISO 14644-1). The testing laboratory is accredited for this analysis according to DIN EN ISO/IEC 17025 and audited regularly by external, independent accreditation bodies. To avoid any possible cherry-picking, up to 600 single SEM images of each implant are digitally composed to one large image with an extremely high resolution, providing a perfect overview of the implant cleanliness.

The final results of the comprehensive Implant Study 2017–2018 with SEM/EDS data on zirconia and titanium implants will be presented at the 2019 IAOCI (International Academy of Ceramic Implantology) World Congress in Tampa, Florida, USA. The comparison regarding the cleanliness of titanium and ceramic implants may probably surprise some participants and may show, that “all that glitters ain’t gold”; that is, all that is white, is not necessarily clean. In other words, dentists should not only rely on the given marketing information to make a conscientious decision on a titanium or zirconia implant system.

When it comes to the question of implant production quality, we all should act according to a Lenin quote: “Trust is good, but control is better.”

More information and a corresponding newsletter can be found on the project’s website www.cleanimplant.com.

contact
Dr Dirk U. Duddeck
Managing Director
CleanImplant Foundation CIF GmbH
Pariser Platz 4a
10117 Berlin, Germany
Phone: +49 171 5477991
duddeck@cleanimplant.com
www.cleanimplant.com
Ceramic implant vs endodontic treatment

Dr Dr Johann Lechner, PhD, Germany

Introduction

Where are the evaluation criteria to determine the success of endodontic treatment? Why are there no additional tools to determine local painlessness versus a systemic toxicity focused approach? How can patients be convinced to get their root fillings replaced with immediate ceramic implants? In the following, scientific based arguments will be given from an author having 16 years of experience in ceramic implants. His scientific based publications are being released in international PubMed indexed medical journals and the research on this topic was published in the International Journal of General Medicine (“Stimulation of pro-inflammatory cytokines by volatile sulfur compounds in endodontically-treated teeth”, Lechner, von Baehr).

New methods to reduce risks

Researchers in the field of modern dental endodontics are well aware of the problem of bacterial colonisation in the tubules of root-filled teeth (RFT), and new methods for reducing these risks are constantly being developed. A control X-ray image is standard practice and considered to be the only method used for the diagnostic assessment of RFT. However, X-ray scans are insufficient, since chemically defined toxins cannot be visually identified. Even though X-rays of root canal treatment do not show anomalies, these areas often contain bacteria, as well as inflamed or necrotic tissue, which proves that not all periradicular inflammations can be diagnosed with the help of X-rays. Anaerobes are sulfate-reducing bacteria and are most frequently isolated from primarily and secondarily infected root canals. Persistent microorganisms in endodontically-treated teeth are the main producers of methyl mercaptan, dimethyl sulfide and diethyl sulfide (Merc/Thio). In the past, there was no process available to reliably identify RFT, using the suspected outgas of Merc/Thio produced by bacterial degradation products and biogenic amines in the form of volatile sulfur compounds (VSC). Thus, we expanded our investigation to develop an additional evaluation criterion in order to semiquantitatively determine the presence of VSC, using a volatile sulfur hydrogen compound indicator (VSHCI).

The chairside test

Hydrogen sulfide can be displayed by utilising the chairside test called OroTox®. The procedure is painless and simple to perform: A nonsterile paper tip—or alternatively, a small sponge, is inserted into the sulcus of the suspected tooth. After one minute it is removed and the sample from the sulcus fluid is inserted into the volatile compound reagent container. After five minutes, the staining of the reagent is examined: The more hydrogen sulfide compounds are present in the sample, the more the indicator liquid turns yellow. The VSCI detects the elevated discharge of bacterial toxins in the sulcus of the suspected teeth, based on six gradings (0 = zero; 1 = moderate; 2 = evident; 3 = clear; 4 = strong; and 5 = extremely strong). The degree of colouration of the reagent may be used to semiquantitatively determine the amount of toxin that can be resorbed in the sulcus (Fig. 1).

The chairside test helps dentists to decide whether RFT should be viewed as critical for a patient with immunological diseases, due to a high Merc/Thio content, even if X-rays of the root tip do not indicate signs of change. We have evaluated the ex vivo immune response of peripheral blood mononuclear cells (PBMC) to VSC in 354 patients with systemic diseases. The findings correlate with semi-quantitative values of a volatile sulfur compound indicator (VSCI) applied directly to the RFT. Our data elucidate the role of VSC in patients with immunologic diseases and the role of the chairside test OroTox® in correlation to IFNg and IL-10 sensitisation in PBMC. The connection between

Fig. 1: The semi-quantitative chairside test; colour change indicates higher concentration of sulfhydryls.
Identifying disease correlations

Scientific research finds that diabetes correlates significantly with a higher prevalence of periapical radiolucencies in endodontically treated teeth. In contrast, critics of root canals believe that they may contribute to immunological diseases and consider X-ray imaging to be insufficient for the purpose of determining possible systemic effects of toxins that derive from root fillings. Apical periodontitis (AP) is a chronic inflammatory disorder of the periradicular tissues caused by bacterial invasion at the apex of the tooth root. There are epidemiologic studies proving the correlation between AP and various diseases. For example, AP is associated with increased rates of myocardial infarction (with acute coronary syndromes occurring 2.7 times more frequently in patients with such infections), as well as clinical depression, increasingly severe depression and a reduced quality of life. Moreover, AP is also associated with an increase in the translocation of gram-negative bacteria. A study on a total of 248 patients with acute myocardial infarction, as well as 249 healthy controls underlines that patients, who have experienced a myocardial infarction, had a higher risk of developing inflammatory processes—especially of endodontic origin—than healthy patients. Patients presenting lesions of endodontic origin or pulp inflammation had an increased risk of developing a coronary heart disease. Bacterial DNA that is typical for an endodontic infection, mainly oral viridans streptococci, was measured in 78.2% of thrombi, and periodontal pathogens were measured in 34.7%. Dental infections and oral bacteria, especially viridans streptococci, are associated with the development of an acute coronary thrombosis. There is also a significant correlation between periodontitis and depression.

However, there is no data showing a correlation between VSC levels in the root canals of patients with AP and systemic and immunological diseases. We presented a study, which is one of the first to statistically link a group of patients to multiple systemic and immunological diseases (SyD) with endotoxin levels originating from AP (Dentistry, Volume 8, Issue 3; “Impact of Endodontically Treated Teeth on Systemic Diseases”; Lechner, von Baehr). The study indicates there is a significant increase in root canal endotoxin levels in patients with AP, in comparison to healthy controls (HC) without AP. The comparison made between the HC and SyD groups provides the first indication of the possible connections between RFT and SyD. It indicates that endodontically treated and root-filled teeth may enhance immunological and systemic disturbances on the one hand and may be involved in the development of SyD on the other hand. Vice versa, the presence of SyD may influence, in some way, local inflammatory reactions such as AP. High local H2S values with the reagent, as well as a high frequency of immunosensitisation to biogenic amines in patients with SyD amplify this correlation. With regard to the increasing prevalence of immune system diseases, widespread endodontic measures should be assessed more critically. For practitioners, the local measurement of VSC, using the OroTox® test, draws attention to the correlation between the outcome of endodontic treatment and systemic diseases. For more than 15 years, we offer ceramic implant replacements as an alternative to RFT in order to help successfully avoiding SyD in our patients.

Contact

Dr Dr Johann Lechner, PhD
Head of Clinic for Integrative Dentistry
Grünewaldstraße 10A
81547 Munich, Germany
Tel.: +49 89 6970129
drlechner@aol.com
www.dr-lechner.de
Why choose a zirconia implant?

Zirconia dental implants are increasing in popularity. More and more companies are offering zirconia implants as part of their portfolio. High aesthetics, increasing cases of titanium sensitivity along with clear health advantages are indicating zirconia as material of choice for dental implants. The main reasons for choosing zirconia include:

**Outstanding aesthetics**
The beautiful white tooth colour of zirconia looks natural and cannot be seen through mucosal tissue.

**Allergies and sensitivities**
Some patients may be allergic to metal. Zirconia implants, made of a non-metal, ceramic material, have not been documented to cause any allergic reaction in patients.

**Strength**
Zirconia shows superior biomechanical properties like high fracture toughness and bending strength, giving zirconia implants the ability to withstand masticatory forces.

**Biocompatible**
Zirconia is a biocompatible material, which was FDA approved and thus considered to be safe. This means that implants made of zirconia interact favourably with the human body and are non-toxic.

**No release of titanium ions**
Recent studies are indicating that increased levels of dissolved titanium, which are released into the surrounding tissue by titanium implants, are associated with peri-implantitis.¹

**Changes for the better**
Dental ceramic is one of the most preferred materials in modern fixed prosthodontics. Metal amalgam fillings are hardly in use in dentistry anymore and the next step will be for dental professionals to adopt zirconia implants as material of choice in their practices.

**Optimal osseointegration**
Results of clinical studies demonstrate that osseointegration of zirconia implants is comparable with titanium implants.

**Low plaque affinity**
Zirconia implants have low plaque affinity creating an oral environment that promotes healthier mucosa, low amounts of inflammatory infiltrate and good soft-tissue integration resulting in a lower risk for peri-implant disease.

**Health conscious patients**
Nowadays, patients are more health conscious than ever before. Zirconia implants address these patient needs. They are white, coloured like a natural tooth and provide a highly-aesthetic and metal-free alternative to implants made of titanium.

**Scientifically proven**
In Europe zirconia implants have been in use since the late 1980’s and in US since 2007 with very promising results.

**Closer to nature**
Blood flow in tissue surrounding zirconia is similar to that in soft tissue around natural teeth.²

**Contact**

TAV Dental
Shlomi, Israel
Phone: +972 4 9808615
info@tavdental.com
www.tavdental.com

¹. http://www.biomaterials.org/content/40/1/5196.full
². http://www.biomaterials.org/content/40/1/5196.full