Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

INTRODUCTION

During the last years, dental implantology has already become one of the fast-growing and innovation-rich fields in dentistry, while analysts forecast a significant increase in the nearest future. Compared to the traditional prosthetic methods, endosseous implantology combines relatively simple and stress-free treatment with a high degree of patient satisfaction and numerous benefits. For example, the physiological implantation of dental structures with the transfer of occlusal forces into the bone via implants may, in certain circumstances, lead to bone re-growth.

One of the most common complications in implantology is peri-implantitis, which, when not properly treated, leads to implant loss. It’s a frequent topic of discussion within the industry and an area of patients’ concern. In the beginning, the diseased tissue appears ads mucositis, with progressive bone loss around the implant area (see Albrektsson et al. 1994). The discrepancy between some scientific views and the daily clinical experience
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

with dental implants has made the topic of peri-implantitis very complex and controversial, and various hypotheses were proposed. Lack of fixed gingiva, poor oral hygiene, smoking, over-torqued implants – those triggering factors contradict the conclusions clinical scientists came to as a result of studies: “An absence or insufficient width of keratinized gingiva is not linked to the development of peri-implantitis”, “A functional strain put on implant cannot be solely responsible for progressive bone resorption”. As we can see, the matter is complicated, while pathologic influences, which cause the disease, should be searched elsewhere.

Different therapy methods are suggested, including improved oral hygiene methods (peri-implantar pockets sonic fusion cleaning), disinfectant inserts and even laser curettage of damaged tissues. However, the best therapy of peri-implantitis will be efficient prevention of the disease.

Fig 2. SEM (1800×) image of plaque formation on surface of the dental implant – abutment connection.

Vitality stain of subgingival plaque.

a) Plaque derived from a healthy patient that primarily consists of cocci.
b) Plaque derived from a patient with periodontitis. Note the important morphologic differences from a) Green bacteria are alive; red bacteria are dead.
HOLLOW SPACES ON IMPLANTS

Since the emergence of dental implants, manufacturers paid special attention to the design of the implants itself, numerous clinical studies have been carried out to measure the gaps and investigate the necessary construction changes to improve the situation. Unfortunately, according to the basic mechanic’s principles, every 2-piece system will always have gaps. It’s a system and complex problem: Due to the design basics of composite implants, there are always be hollow spaces between implants and abutments, at the connection point, as well as throughout the thread and at the interior of the implant. This statement is true for the conical connection implants as well.

Fig 3. Endo-axis implant, gaps and cavities are marked in red.

1. Due to the design of composite implants, micro-slots remain between the implant and the abutment, as well as along the entire thread, plus inside the implant shaft itself.
2. Even with an optimal processing, the surface roughness leaves a huge potential for micro-biological life.
**IMPLANT RE-INFECTION**

Every dental implant professional is familiar with the foul smell which happens after opening the assembled implant-abutment structure (for example, after replacing healing caps with abutment). The reason is bacterial colonies. The implant gets contaminated with germs from the oral cavity immediately after the insertion. Bacteria growth starts immediately after locking the fixation screw. The conditions - warmth, humidity and nutrients supply – are ideal for the bacteria and fungi. It enables bacterial growth and colonisation, following by a re-infection of peri-implant tissue, back through the outward gaps. Though the antimicrobial treatment of the area around the implant is often applied (CHX solution is a common choice). However, this material does not fight fungi and viruses, and the anti-bacterial effect

![Image of a woman covering her mouth with text: IMPLANT RE-INFECTION](image.png)

**Fig 4. Size of an erythrocyte and implant/abutment – gap relation (magnification 1:1500).**
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

According to the studies, the average implant-abutment gap measured stands on 40 micron. To make the proportions clear, we put the erythrocyte (7 micron) near the gap.

This problem is true for superstructures as well. While being sealed by the fastened cement at first, putrid smell that emerges when cement is drilled from a crown gives the evidence that germs are permeating here. The multi-unit and other multi-piece combined superstructure systems are even more vulnerable: the gaps in screw-retained restorations and those supported by widely varying attachments can be classified in order of up to few millimetres.

The dimensions of the pathogenic bacterias near the erythrocyte matching its size to scale.

a) Erythrocyte < 7 μ.
b) Gas gangrene bacillus < 4 μ.
c) Anthrax bacillus < 3 μ.
d) Typhoid bacteria < 1.5 μ.
e) Influenza bacteria < 0.2 μ.
f) Cocci < 0.8 μ.
g) Pox virus < 0.15 μ.
h) Foot and mouth disease virus < 0.012 μ.

μ = 10^−6 m.
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

**VIRUSEAL EFFICIENCY**

Viruseal provides the reliable seal and fills the hollow spaces between implant-abutment composite systems and inside the implant shaft. Highly viscous silicone matrix ensures a reliable sealing and prevents the ingress of microorganisms. The core principle of the ViruSeal effect is simple – where’s the place is already occupied and no nutrition for vital activity, nothing else can grow and develop. The addition of natural monoterpenoid derivative of cymene ingredient (thymol), known for its outstanding antibacterial and antiseptic properties, effectively fights germs and prevents plague. The ViruSeal does not lose its consistency; it doesn’t dry out or shrink, so the new gaps do not form. The material keeps the viscosity and can be quickly removed or replaced.

![Fig 5-1. SEM (1400×) image of imperfections on the external surface of the dental implant platform.](image)

![Fig 5. Microgap disclosure (SEM: 5000×) on implant and abutment connection interface.](image)
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

when necessary. The bactericidal, fungicidal and virucidal properties, prevent a Viruseal from becoming a carrier of infection. All ingredients are completely harmless and cause no allergic reactions. Despite the fact that ViruSeal is not injected into the body, it is still a proven advantage worth noticing. ViruSeal can be applied unconditionally on all patients.

**MICRO-GAPS**

Implant-assisted dental restorations act as a functional unit with the bone, and every mismatch between the implant assembly components causes adverse effects on both the bone and the implant. Complications associated with micro-gaps and micro-leakages are divided into two categories. First, biological complications, mentioned previously, as peri-implant mucositis, peri-implantitis, crestal bone resorption. Second, mechanical problems, including abutment screw loosening and abutment/implant neck fracture.
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

The ViruSeal high viscosity improves the anchorage of telescopic or conical restorations by increasing the retention. The thixotropic properties of the base material prevent the formation of calculus. Thin silicone film effectively prevents the adhesion of plaque on the supporting elements.

In the era of modern implantology, peri-implantitis has become a most feared complication. Numerous efforts have been made to prevent the reinfection of hollow spaces – a main pathogenic factor for peri-implantitis. Additional microleakage factors include the torque applied, close match of the component surfaces, and occlusal loading. Despite the growing precision at the implant manufacturing process, metal-to-metal implant-abutment structure cannot be perfectly sealed.

In conclusion, ViruSeal can increase the lifespan of implant-based restoration by significantly reducing the gap size, the amount of leakage and preventing micromovements of the composite implant structures.
Evaluation of sealing between abutment and inner connection of dental implant: microgaps between implant and abutment.

REFERENCES


