Peri-implantitis prophylaxis by sealing implant gaps and hollow spaces

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_Introduction

In the last decades, implantology has emerged as one of the most innovative enrichments in the field of dentistry. Considerable increase is expected in the future. Compared to earlier preprosthetic methods, endosseous implantology is a simple treatment that usually is not very stressful for the patients and offers many advantages, e.g. the physiological transfer of chewing forces into the bone, which—under certain conditions—even generates renewed bone growth.

Against this background, implantology with all its prosthetic treatment varieties is considered an established method. One of the most common and most feared complications occurring in implantology is peri-implantitis (Figs. 1a & b), which usually leads to implant loss when it remains untreated.

Initially, the periimplant tissue disease manifests itself as mucositis with progressive bone loss at the implant area, as described by Albrektsson et al.[1] The reasons for this disease pattern are complex, and various hypotheses about the development of peri-implantitis were proposed, amongst them insufficient oral hygiene, lack of fixed gingiva, and/or overstressed implants. These putative triggering factors contradict the statements of well-known implantologists, "An absence or insufficient width of keratinized gingiva is not linked aetiologically to the development of gingivitis and peri-implantitis" or "The functional strain placed on an implant cannot be solely held responsible for progressive bone loss".[8,17] That means that additional pathologic influences, which trigger and sustain the progress of the disease, must exist next to these ostensible causes.

Therapies reach from improved basic hygiene to antibiotics and disinfectant inserts into periimplant pockets up to ultrasound treatments and laser curettage of inflamed tissues.[4,8] The main attention, however, should not be placed on therapy, but rather onto an efficient prevention of peri-implantitis.

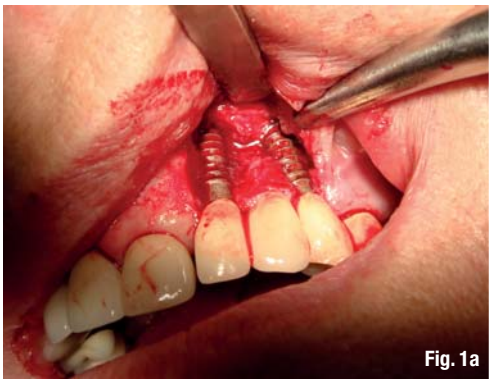
Fig. 1a

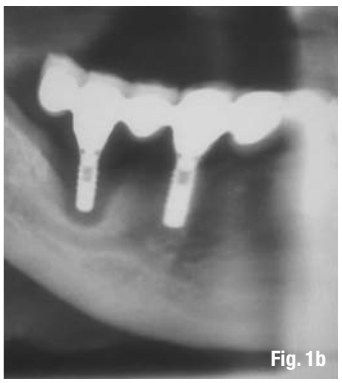
Fig. 1b

Fig. 1a_Peri-implantitis, clinically.
Fig. 1b_X-ray of peri-implantitis.

_Gaps and hollow spaces of assembled implants

It is a fact that assembled implants contain hollow spaces, which can be minimised but not prevented even by the most meticulous production. Because threads also hold gaps, the contamination of implant interiors with germs originating from the oral cavity is inevitable.[2,11]

Re-infection from an implant cannot be ruled out. On almost every assembled implant we noticed a putrid smell of its content, which was extracted with a cotton tip. In 1996 we initiated examinations which confirmed the assumption that gaps and hollow spaces in interior implants were contaminated with germs, which matched the germ spectrum of an interdental smear.[4,5,9,12,14,15]

Implant interiors in their dimensions, position and size are easily recognised by construction drawings, cross sectional shapes and X-rays, and so it be-

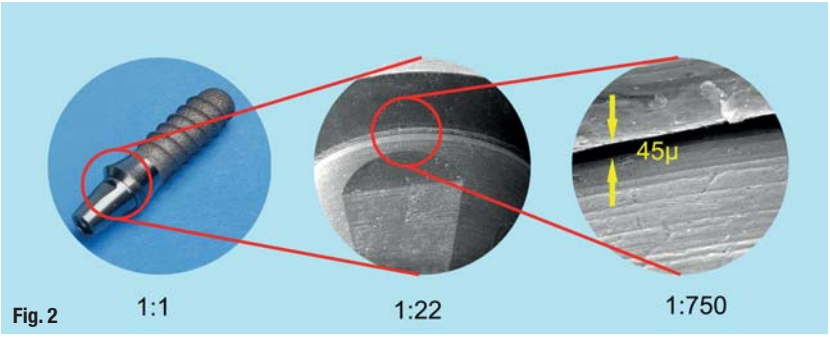

Fig. 2

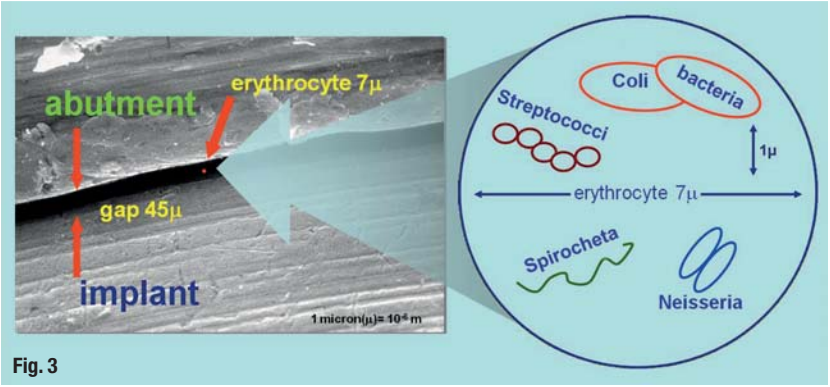

Fig. 3

Fig. 2_Used implant randomly chosen, on which the marked area was light and electron microscopically examined (Brand is unnamed intentionally).

Fig. 3_Gap situation between implant and abutment compared to an erythrocyte with a diameter of 7 µ (1 µ = 10^{-6} m), 745 times enlarged. The randomly chosen germs are depicted true to scale and compared to an erythrocyte.

comes clear that hardly any assembled implant is actually excluded from those facts.[7]

Of course, these considerations apply to screwed superstructures as well. Cemented superstructures seem to be sealed at first by the fastening cement, but everyone knows the smell that emerges when cement is drilled from crown and bridgework and gives evidence of germs permeating here as well.

The access paths of germs into the implant interior are easily comprehendible, and we were able to provide evidence by taking light and electron microscopic exposures of a used implant (Fig. 2). The paper "Implant Component Compatibility" by Binon et al. confirms this matter quite impressively.[3] The results showed that the macroscopically good fit revealed severe flaws under electron microscopic examination.

Furthermore, the capillary forces and micro motions18 between implant and abutment promote the exchange of infectious material, for which saliva is a good vehicle. Figure 3 shows the proportion of the gap located between implant and abutment compared to an erythrocyte.[7] In order to make the dimensions even more clearly, the randomly chosen germs shown are also matched to an erythrocyte exactly to scale.[13]

_Peri-implantitis through re-infection from an implant

The implant is contaminated with germs from the oral cavity as soon as it is opened for placement of the insertion tool. Germ growth starts immediately after fastening the locking screw, unless the implant interiors were previously treated with a material for sealing and combatting germs.

The breeding conditions—warmth, humidity and supply—enable bacterial growth and fungal colonisation in an ideal manner, so that re-infection of periimplant tissues via the gaps leading outwards is given. Regardless of which treatment of this important area around the implant is applied, it will always remain short-lived.

_Development and efficacy of GapSeal®

In order to counteract these re-infections, we developed a material based on a highly viscous silicone matrix and a bactericidal disinfectant in 1996. Antibiotics would not be sufficiently intensive or effective in a low dose. Moreover, they would contribute to sensitisation and the development of resistance. Afterwards we employed the so-called split-mouth technique to test the material against white Vaseline and determine the required admixture of disinfectant.[15]

The sealing material thymol has bactericidal, virucidal and fungicidal properties. It belongs to the microbiologically very effective materials, but is largely harmless to humans. Its disinfecting effect is about 30 times higher than that of phenol, but thymol has only a quarter of its toxicity. It also does not cause allergies.[10,16] The material met its purpose as gap and interior sealant more than satisfactorily and was subsequently named "GapSeal®" (Fig. 4).[6]

For the split-mouth studies, GapSeal® was applied to the right sides of the implants, and Vaseline to the left sides. During this clinical comparison, the Vaseline turned out to be thoroughly contaminated,

Fig. 4_Sterilisable GapSeal® applicator with GapSeal® carpules.

Fig. 4

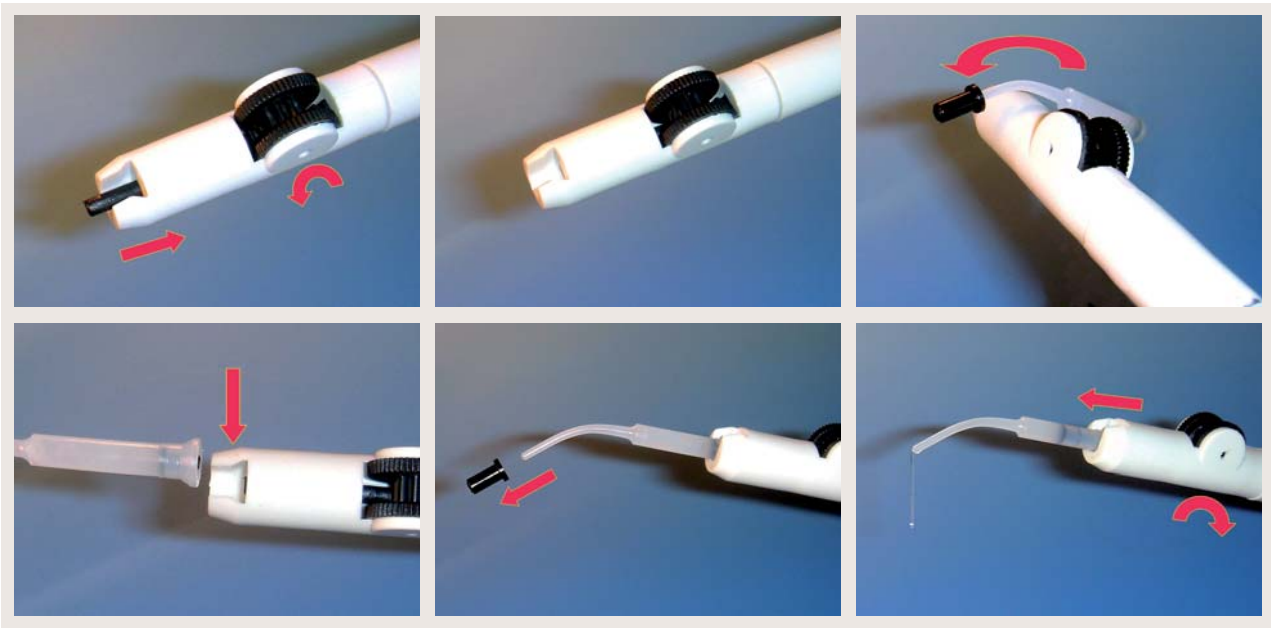

Fig. 6_Use of applicator and carpules.

while GapSeal®-treated implants usually provided no evidence of germ growth. This is proven by the follow-up examinations, each of which was conducted six months afterwards.

The number of germs (CFU = colony forming unit) at each pertaining implant was determined through serial dilution, followed by counting the CFU's on the incubation plates. This process enabled a definite determination of germs contained in each interior implant smear.[15] We were able to prove the material's efficacy by conducting follow-up examinations between 1996 and 2000 and do not want to abstain from using GapSeal® ever since. These studies finally showed a statistically significant reduction in peri-implantitis in more than a third of all implants sealed with GapSeal®.[15]

_Application

Implant interiors can be sealed with GapSeal® immediately after inserting and removing the insertion tool, thereby eliminating the prospective peri-implantitis inducing the re-infection factor. For this purpose, the carpule must be inserted into the applicator at first, and the closing cap needs to be removed. It is recommended to bend the cannula slightly around the applicator shaft according to the filling situation. Excess material gushing from the implant when the closure cap is screwed in indicates a good filling situation (Fig. 6).

The material is delivered in sterile blister packs and the applicator is autoclavable to warrant sterility. In case the implant is treated with GapSeal® at a later point, thorough cleansing of the interior spaces with alcohol is recommended. Furthermore, it is advised to fill the hollow spaces of screwed superstructures with GapSeal®. During implant re-entry at recalls, it is advisable to renew old material, which may be rinsed out with xylene or alcohol. GapSeal® is very stable; it retains its qualities in cemented works over years, and requires neither exchange nor replenishment.

_Results and discussion

Peri-implantitis is the most feared complication occurring in implantology, especially once the implant therapy with appropriate prosthetics is completed. Suggestions regarding the treatment exist in ample variations and are also put into practice. However, it seems to be more reasonable to prevent the causes for peri-implantitis, which certainly originate to a large percentage from re-infection out of implant gaps and hollow spaces. The possibility of germ colonisation in implant interiors exists and should be taken seriously. Attempts to combat re-infection have been described in specialised literature for years. Now GapSeal® with its sixteen years of clinical experience offers a truly effective prevention against peri-implantitis._

Editorial note: A list of references is available from the publisher.

_contact implants

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