Rainer Buchmann
Fouad Khoury
Dieter Pingel
Dieter E. Lange

The microflora recovered from the outer-surfaces of the Frialit-2 implanto-prosthetic connector

Authors' affiliations:
Rainer Buchmann, Department of Periodontology and Oral Biology, Goldman School of Dental Medicine, Boston University, USA
Fouad Khoury, Schellenstein Clinical for Oral Implant Dentistry, Olsberg, Germany
Dieter Pingel, Department of Prosthetic Dentistry, Westfalian Wilhelms-University, Münster, Germany
Dieter E. Lange, Department of Periodontology, Westfalian Wilhelms-University, Münster, Germany

Correspondence to:
Rainer Buchmann, Dr.med.dent., PD,
Bussardstrasse 6
D-59071 Hamm
Germany
Tel./Fax: +49 2381 439843
e-mail: rainer-buchmann@yahoo.de

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Abstract: The aim of the present investigation was to examine the outer-surface microbiota of the prosthetic connector of Frialit-2 implants, and to compare the microbial findings with the peri-implant parameters 2 years after functional loading. In 16 implant-treated patients (55.8 ± 9.5 years) the outer-surface micro-organisms of the prosthetic connectors were determined in 32 Frialit-2 implants. The functional loading time of the prosthetic suprastructures was 24.1 ± 13.8 months on average. After removal of the implant-supported restoration, microbial samples were obtained from the outer-surfaces of the Frialit-2 prosthetic connector. The microbial plaque samples were specified on CDC-blood agar as percentages of the total cultivable flora. *Actinobacillus actinomycetemcomitans* was semiquantitively determined on TSBV-agar in CFU/ml. The microbial plaque samples were dominated by *Actinomyces israelii* (68.8%), *Eubacterium lentum* (56.3%) and *Veillonella parvula* (43.8%) with proportions ranking between 3.9% (*V. parvula*) and 11.1% (*A. israelii*). The most frequently detected gram-negative microorganisms were *Fusobacterium nucleatum* (87.5%), *Porphyromonas gingivalis* (81.3%), and *Peptostreptococcus micros* (68.8%) with enhanced proportions for *P. gingivalis* (11.4%) and *P. micros* (11.4%). No statistical significant correlation could be established between the microbiota present on the outer-surfaces of the F2-connector and the peri-implant parameters examined. The outer-surface microflora recovered from the implanto-prosthetic-connector of Frialit-2 implants reveals a colonization with gram-positive bacteria and potentially harmful gram-negative micro-organisms that were frequently detected, but present at low levels. After 2 years of restorative loading, the outer-surface microbial colonization is compatible with peri-implant soft tissue health.

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Several lines of evidence indicate that the microflora of dental implants is similar to that associated with natural teeth. In edentulous patients, the primary sources of colonization for implants are the oral mucous membranes. Subjects wearing implants with a past history of periodontitis harbour bacteria associated with a healthy periodontium or gingivitis (Mombelli et al. 1988; Danser et al. 1997). In partial edentulism, microbial changes are observed the longer the implants have been in function, and in those patients with a history of periodontal or peri-implant infections. Furthermore, it has been shown that the microbiota of the oral cavity present before implant installation determines the bacterial composition of the peri-implant environment (Mombelli et al. 1995; Papaioannou et al. 1996).

It is well documented that the microflora of crowned implants and crowned

teeth is similar regardless of one- or two-stage implants or implants supporting single or multiple restorations (Lee et al. 1999). However, the microbiota between the implant and the covering suprastructures that might affect the perimucosal area has not yet been determined in detail. *In vitro* studies of the Brånemark system revealed that fit discrepancies of 50–100 µm between the implant and the connecting suprastructure exist due to flexibility in the framework and the prosthodontic components (Millington & Leung 1995; Smedberg et al. 1996). The lack of mechanical fit between the crown and the implant shoulder may allow indigenous microbiota of the oral cavity to colonize the implant-crown assemblies.

Recently, microbial species underneath the implant restorations have been identified in a comparative study on cemented and screw-retained one-stage ITI-implant prostheses. The authors concluded that the microflora of the oral cavity is the determining factor for the microbial colonization of implants (Keller et al. 1998). The mode of fixation of the suprastructures was less important. According to the concept that, in partial edentulous patients bacteria of the dental microflora subsequently colonize the peri-implant environment, one should expect that implant-crown assemblies of two-stage implants also reveal a microbial colonization similar to that of the residual dentition. In contrast to one-stage implants, a bacterial contribution from internal connecting elements has to be considered. However, the clinical relevance has not yet been understood completely (Quirynen & van Steenberghe 1993; Quirynen et al. 1994).

The objective of the present investigation was to determine the outer-surface microbiota adherent to the Frialit-2 implanto-prosthetic-connector, and to compare the microbial findings with the peri-implant conditions.

Material and methods

Patients

The data for this study were taken from 16 subjects from the Department of Prosthetic Dentistry, Department of Periodontology, and Schellenstein Clinic for Implant Dentistry with an average age of 55.8 ± 9.5 years and a total of 32 Frialit 2-dental implants (Friadent GmbH, Mannheim, Germany). Only partial-edentulous patients who had received comprehensive treatment for periodontal disease prior to implant therapy, and participated in an implanto-prosthetic maintenance program, took part in the study. The F2-implants were placed *in situ* for 28.9 ± 14.4 months, displayed a functional loading-period of 24.1 ± 13.8 months on average, and had no history of recent peri-implant disease. All study subjects wore either removable or fixed partial dentures. Health questionnaires were administered to the patients eliciting information regarding tobacco use, drug and alcohol consumption or antibiotics in the previous 6 months, and any systemic condition that might have affected the health of peri-implant tissues. Patients requiring additional antibiotic medications related to other acute infectious diseases were not permitted to participate. In Table 1, the baseline demographic characteristics of the 16 F2-implant patients enrolled in the study are represented.

Peri-implant parameters

Subjects fulfilling the inclusion criteria above were invited for participation in the study and, if accepted, signed informed consent forms. All patients were monitored once within the maintenance program. The probing depths (PD) as distance between the margin of the peri-implant gingiva and the bottom of the peri-implant pocket were achieved at four sites per implant (buccal: mb/db; lingual: dl/ml) using a straight rigid periodontal probe (PCP 11, HuFriedy, Chicago, IL, USA) with a 3-3–2-3 mm calibration and a 0.4-mm diameter tip. The PD measurements (reproducibility ± 1 mm greater than 95%) were performed by the same calibrated examiner. The presence of plaque was assessed at four sites per implant-abutment according to the plaque index (PI), and was scored from 0 to 3, related to the amount of visible plaque on the implant-surface area (Silness & Löe 1964). The gingival conditions were visually examined at four surfaces per implant using the gingival index (GI) applied to the peri-implant gingiva that classifies the redness and swelling of the peri-implant gingiva into degrees 0–3 (Löe & Silness 1963).

Microbial examinations

Following removal of the prosthetic suprastructures, plaque samples were obtained from the outer-surfaces of two implanto-prosthetic-connectors in each patient with the most visible plaque available (Fig. 1a, b, c). Only implants with abutment screws evaluated as stable were considered for microbial examination. After isolating the area with a cotton roll and gently air drying, the implanto-prosthetic-connector was unscrewed, removed, and the outer part immediately placed into an Eppendorf vial with 500 µl 1/4 concentrated, ice-cold, filter-sterilized Ringers solution and continuously rotated for 10 s while fixing the opposite, inner part of the connector with a forceps.

The undiluted suspension (0.1 ml) and 0.1 ml aliquots (1 : 10, 1 : 100 and 1 : 1000) of the dilutions were spread on plates with non-selective blood agar base (CDC) containing 5% defribinated sheep blood, supplemented with 5 mg/l hemin (Merck, Darmstadt, Germany) and 1 mg/l vitamin K1. The plates were incubated for 7 days in an atmosphere containing 85% N_2, 10% H_2 and 5% CO_2. From the anaerobic culture, only agar plates were chosen for further identification of the bacterial morphotypes when the colony count onto each plate exceeded more than 100 colonies.

Table 1. **Demographic characteristics of 16 Frialit two-implant-treated subjects enrolled in the study**

	F2 (3.8 mm[a])	F2 (4.5 mm)	F2 (5.5 mm)	Total
Subjects (*n*)	8	6	2	16
Gender (m/f)	3/5	4/2	1/1	8/8
Age (years)	51.4 ± 8.1	53.9 ± 7.9	62.1 ± 4.6	55.8 ± 9.5
Number of implants examined	16	12	4	32
Implantation (months)	29.2 ± 13.7	32.2 ± 14.1	25.5 ± 13.3	28.9 ± 14.4
Functional loading (months)	22.7 ± 12.9	25.1 ± 13.5	24.6 ± 12.7	24.1 ± 13.8

[a]F2-implant diameter.

Thirteen bacterial taxa per plaque sample were identified representing the predominant species of the total cultivable flora. The identification of the bacterial colony morphotypes was performed with the detection system Rapid ID 32 A (Bio Merieux, Nürtingen, Germany). The detection system Rapid ID 32 A is based on fermentative and biochemical properties of anaerobic micro-organisms being identified by standard enzymatic reactions. Aliquots of bacterial suspensions prepared from the incubated subculture are given on a test panel consisting of 29 biochemical tests. The results of these tests are interpreted by comparing all the results obtained for the test micro-organisms with the information in the computer-assisted database ATB 32 (Arzese et al. 1994).

For quantitative enumeration of *Actinobacillus actinomycetemcomitans* on the outer-surface plaque samples (detection limit: 100 cells/ml), 0.1 ml of the transport medium was diluted to 10^{-1} and 10^{-2} and spread on freshly prepared TSBV-agar (Slots 1982). To identify and determine the biotype the sheets were incubated in a CO_2 (5%) enriched incubator for 3 days at 35°C. Catalase-positive, small, convex colonies with star-shaped inner structures adhering to the agar were identified as *A. actinomycetemcomitans* colonies. The evaluation of *A. actinomycetemcomitans* on TSBV-agar was expressed quantitatively in colony-forming units (CFU/ml).

Implanto-prosthetic maintenance

All individuals were enrolled in a 6-month scheduled individual implanto-prosthetic maintenance program with a full-mouth-screening of periodontal and peri-implant parameters, prophylaxis, and repeated motivation and instruction in self-performed oral hygiene. In a 1-year turnover, additional standardized extraoral orthopantomograms were performed altogether with removal and cleaning both of the supras-

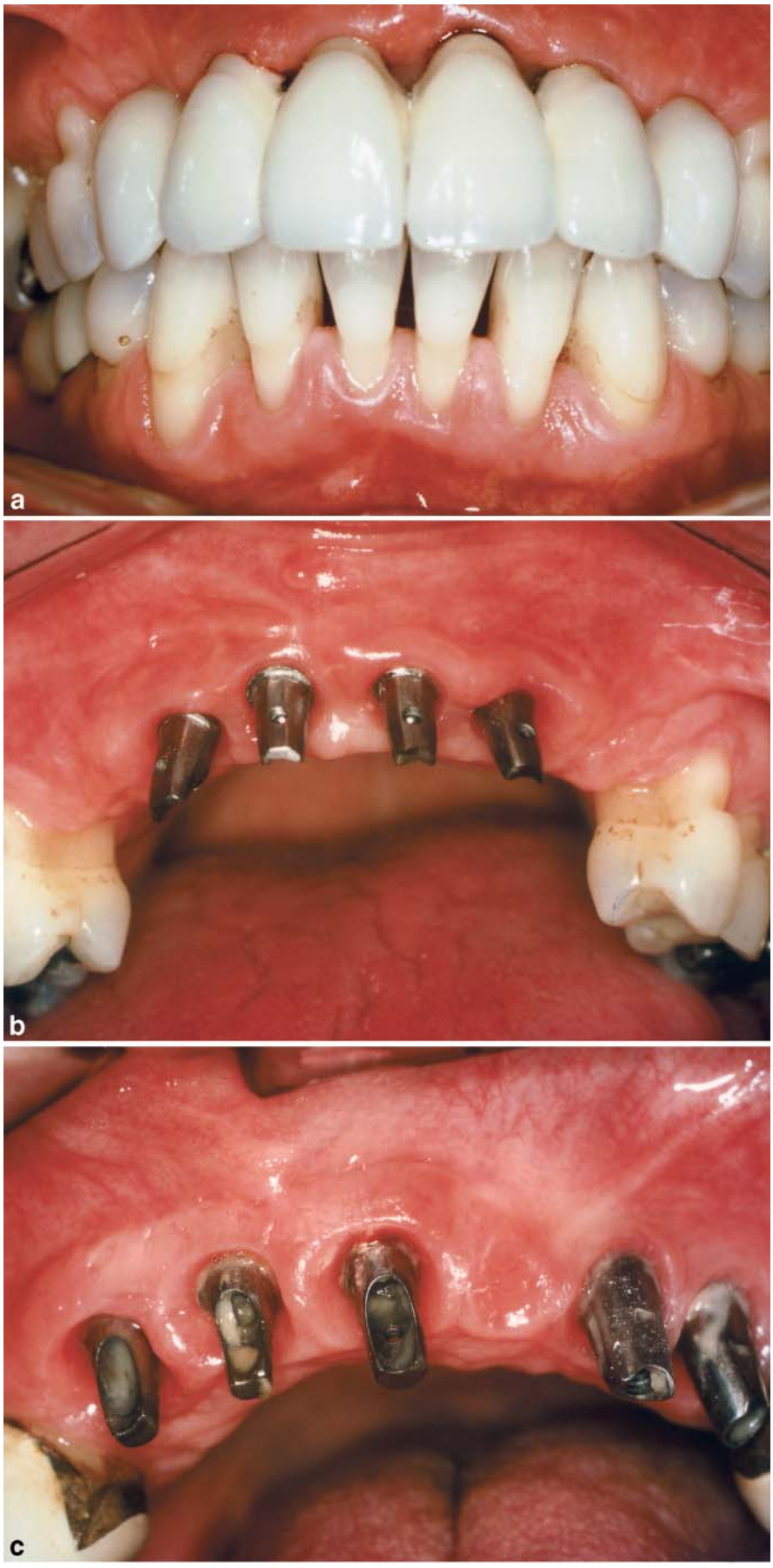

Fig. 1. (a) Clinical status of a 56-year-old patient with four F2-implants regio 12–22 participating in the implanto-prosthetic maintenance program. (b) Outer-surfaces of four F2-prosthetic connectors with healthy peri-implant conditions. Concave shape of the connector fixed towards the oral cavity. (c) 42-year-old subject with concave connector shapes fixed to the vestibular area. Prosthetic connectors regio 12, 23 designated for microbial sampling.

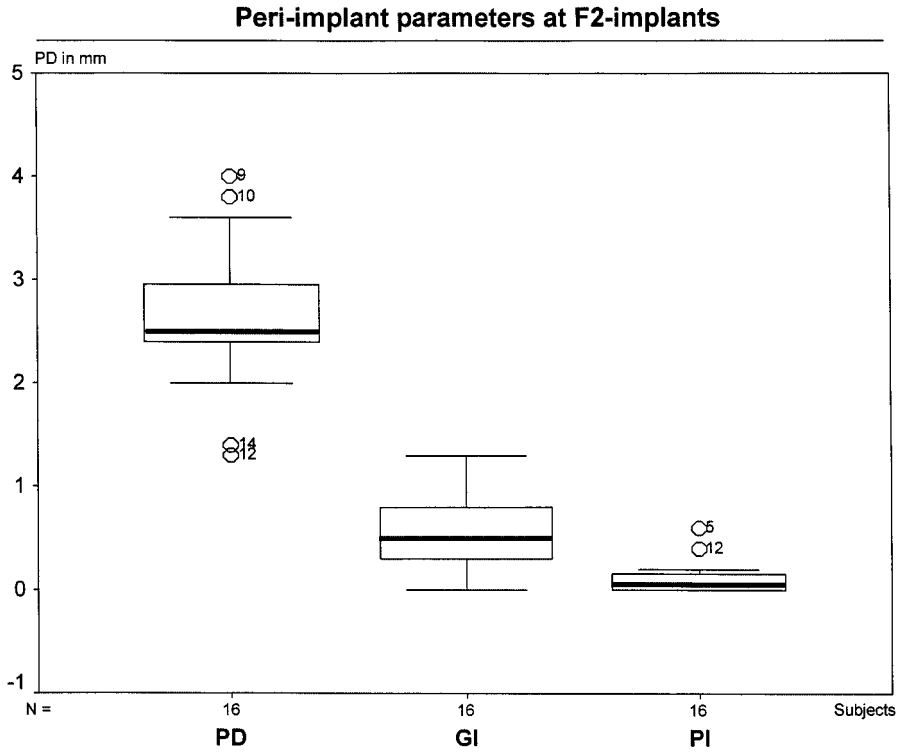

Fig. 2. Boxplots for the medians and Q1-Q3 quartiles of peri-implant probing depths (PD), gingival index (GI) and plaque index (PI) 2 years after functional loading. Lines below and above box plots = minimum, maximum.

tructures and the implanto-prosthetic-connector. The connector and the prosthetic restoration were cleaned with 3%-hydrogenperoxide, and inserted into a 0.1% chlorhexidin-digluconate solution for disinfection. The inner-surfaces of the implant and the peri-implant gingival soft tissue cuff were carefully cleaned with a cotton swab and rinsed with 0.9% sodium chloride. Thereafter, the implanto-prosthetic-connector was reinserted, and the restoration fixed again.

Statistical analysis

The peri-implant and microbial data were calculated on a patient level with the subject as unit of analysis and the implant site as unit of observation. Non-detections of microbial species were treated as zero-values. The microbial data were given as percentages of the total cultivable flora. The correlation between the clinical parameters and the microbial findings was analyzed by bivariate correlation procedures using the Spearman rank correlation coefficient. The α-level for significance was evaluated using the adjusted Bonferoni probability for multiple comparisons. The results were presented descriptively as mean values $\pm$ standard deviations, medians and minima and maxima using the SPSS Base 10.0-software.

Results

Clinical findings

The mean values for the 32 F2-implants with a functional loading-time of 24.1 ± 13.8 months are summarized in Fig. 2 with the boxplots for the medians and Q1-Q3 quartiles of peri-implant PD, GI and PI 2 years after functional loading. The implant sites represented clinically healthy conditions with average peri-implant PD of 2.61 ± 1.04 mm. Both the GI and the PI exhibited low scores of 0.49 ± 0.34 and 0.17 ± 0.22, respectively. Eight subjects with a 3.8-mm implant-diameter, six individuals with a 4.5-mm, and two patients with a 5.5-mm Frialit 2-fixture were examined. The peri-implant status revealed no differences between implants with 3.8, 4.5 and 5.5 mm diameter (data not shown).

Microbiology

The prevalence and proportions of the selected micro-organims from the outer surfaces of the implanto-prosthetic-connectors are summarized in Table 2. The microflora consisted both of gram-positve bacteria and gram-negative micro-organisms, and displayed a high variability, as could be seen by the minima and maxima levels. Low frequency detection levels were encountered for *Peptostreptococcus anguinosus* (25.2%), *Streptococcus sanguinus* (24.1%), *Streptococcus intermedius* (25.4%) and *Propionibacterium acidipropionici* (26.7%). Among the gram-positive flora *Eubacterium lentum* (12.6 ± 11.4%), *Actinomyces israelii* (11.1 ± 11.95%) and *S. sanguinus* (10.5 ± 9.9%) revealed the highest proportions. The average proportions of *S. intermedius*, *Veillonella parvula* and *P. acidipropionici* corresponded to the individually varying microflora of the oral cavity. Among the gram-negative bacteria, *Fusobacterium nucleatum* ($n = 14$), *Porphyromonas gingivalis* ($n = 13$) and *Peptostreptococcus micros* ($n = 11$) could be recovered most frequently. The prevalence scores were 87.5% for *F. nucleatum*, 81.3% for *P. gingivalis* and 68.8% for *P. micros* and *A. israelii*. *P. gingivalis* reached moderate proportions of 11.4 ± 16.3%, and *P. micros* of 11.4 ± 11.3% (mean % of the total cultivable flora). *Bacteroides forsythus* was present with far lower percentages levels of 6.8 ± 8.0%. *A. actinomycetemcomitans* could not be detected in any of the patients.

The bivariate correlation analysis model was calculated to estimate the relationship between the clinical parameters and the outer-surface microbiota of the prosthetic connector, Table 3. Following adjustment by Bonferoni for multiple comparisons, none of the correlations reached statistical significance. These observations indicate that the microflora found underneath the covering suprastructures does not affect any of the peri-implant parameters around the implants.

Discussion

In the present study, we examined the outer-surface microflora adherent to the implanto-prosthetic-connector of screw-retained dental implants. For partial edentulous patients, our findings clearly demonstrate the stability of the clinical parameters in the presence of gram-negative microbiota such as *P. gingivalis*, *B. forsythus* and *P. micros* on the implanto-prosthetic connecting element. These obser

Table 2. **Prevalence and proportions of 14 selected outer-surface microorganisms on the implanto-prosthetic-connector of Frialit-2 implants (n = 16 subjects, 32 implants)**

	n	Prevalence (%)	Mean (%[a])	SD	Median (%)	Min–Max
P. gingivalis	13	81.3	11.42	16.34	5.0	0.0–50.0
B. forsythus	10	62.5	6.79	7.99	5.0	0.0–30.0
P. intermedia	9	56.3	3.42	6.44	0.0	0.0–25.0
P. buccae	5	31.3	2.57	5.80	0.0	0.0–20.0
F. nucleatum	14	87.5	4.64	7.46	0.0	0.0–35.0
P. micros	11	68.8	11.43	11.34	10.0	0.0–20.0
P. anguinosus	4	25.2	7.13	6.67	0.0	0.0–30.0
A. actinomycetemcomitans	–	–	–	–	–	–
S. sanguinus	4	24.1	10.51	9.89	0.0	0.0–30.0
S. intermedius	4	25.4	5.36	8.42	0.0	0.0–25.0
A. israelii	11	68.8	11.07	11.95	7.5	0.0–30.0
V. parvula	7	43.8	3.93	5.61	0.0	0.0–15.0
E. lentum	9	56.3	12.62	11.44	2.5	0.0–30.0
P. acidipropionici	4	26.7	5.71	12.83	0.0	0.0–40.0

[a]Mean %, mean of the total cultivable flora; –, not detected.

vations agree with previous studies that reported the residual dentition as source for the micro-organisms recovered from the peri-implant environment (Koka et al. 1993; Mombelli et al. 1995; Papaioannou et al. 1996). Furthermore, our results confirm the observations of Keller et al. (1998) where peri-implant pathogens were harvested from areas underneath the covering suprastructures. At ITI-implants, the authors reported detection frequencies between 10 and 58% with a significant relationship for the plaque samples of the peri-implant sulcus and underneath the suprastructures. In our investigation at two-stage implants, the occurrence of gram-negative bacteria ranged from 25 to 81% with increased detection frequencies for *F. nucleatum* (88%), *P. gingivalis* (81%) and *P. micros* (69%). This difference might be explained by the contribution of microbiota found in the internal reservoirs of two-stage implants as previously documented (Quirynen & van Steenberghe 1993; Quirynen et al. 1994). It is noteworthy that this microbial contribution does not affect the peri-implant soft tissue conditions as demonstrated by the clinical parameters probing depths, gingival and plaque index.

Actinobacillus actinomycetemcomitans was not detected in any of the microbial plaque samples. Similar observations were made in a prospective 6-month study where none of the ITI and Brånemark type implants were found to be colonized by *A. actinomycetemcomitans*, although the organism was detected on teeth in one individual (Mombelli et al. 1995). In a cross-sectional analysis, *A. actinomycetemcomitans* was recovered in one subject underneath the suprastructures (Keller et al. 1998). In partial edentulism, the presence of *A. actinomycetemcomitans* is associated with peri-implant infections rather than with healthy and maintained implants (Van Winkelhoff et al. 2000). This might be due to altered adhesion mechanisms in the diseased peri-implant site, the failure of the host response to produce adequate levels of biologically functional antibodies, and the clonal change of species in disease conditions that may lead to the emergence of strains with different levels of virulence (Ehmke et al. 1999; Darby et al. 2001).

The data generated in our trial suggest that the outer-surfaces of prosthetic connectors from implants with screw-retained

Table 3. **Spearman rank correlation coefficient (rho) crosstable matrix of peri-implant conditions and outer-surface microbiota of the F2-implanto-prosthetic-connector[a]**

rho	PI	GI	***P.g.***	***B.f.***	*P.i.*	*P.b.*	*F.n.*	*P.m.*	*S.sp.*	*A.is.*	*V.p.*	*E.l.*	*P.a.*
PD	0.258	0.737	− 0.153	0.115	− 0.077	− 0.341	0.312	0.598	0.311	0.174	0.191	− 0.193	− 0.102
PI		− 0.199	− 0.283	− 0.248	0.194	0.491	0.619	− 0.231	− 0.330	− 0.082	0.255	0.172	− 0.327
GI			− 0.198	0.085	0.026	− 0.544	− 0.194	0.620	0.248	0.392	0.160	− 0.227	0.177
P.g.				0.695	0.449	0.258	− 0.068	− 0.213	0.461	− 0.498	− 0.606	− 0.499	− 0.427
B.f.					0.160	0.023	0.095	0.042	0.140	− 0.290	− 0.150	− 0.894	− 0.248
P.i.						0.352	− 0.296	− 0.052	0.199	− 0.423	− 0.300	− 0.166	− 0.211
P.b.							0.265	− 0.414	− 0.433	− 0.536	− 0.380	0.050	− 0.268
F.n.								0.129	− 0.174	− 0.204	0.160	− 0.099	− 0.375
P.m.									− 0.065	0.001	− 0.130	0.017	0.532
S.sp.										− 0.055	− 0.111	− 0.095	− 0.433
A.is.											0.572	0.033	0.118
V.p.												− 0.080	− 0.051
E.l.													0.325

[a]No significant correlations at a level of $\alpha = 0.05$ with Bonferoni correction (α-level adjusted to Bonferoni: 0.05/78 = 0.0006). PD, probing depths; PI, plaque index; GI, gingival index; *P.g., Porphyromonas gingivalis*; *B.f., Bacteroides forsythus*; *P.i., Prevotella intermedia*; *P.b., Prevotella buccae*; *F.n., Fusobacterium nucleatum*; *P.m., Peptostreptococcus micros*; *S.sp., Streptococcus species*; *A.is., Actinomyces israelii*; *V.p.*; *Veillonella parvula*; *E.l., Eubacterium lentum; P.a., Propionibacterium acidipropionicum.*

suprastructures serve as a platform for potentially harmful micro-organisms. In contrast to the sampling method of Keller et al. (1998) where the plaque samples were swabbed from the interior part of the screw-retained ITI-prosthetic restorations with a sterile cotton pellet, we decided to rotate the F2-connector in sterilized Ringers solution. Because of the more complex surface geometry we assume that the prosthetic-connecting elements represent the pathway for colonizing bacteria rather than the restoration itself. Data available in the literature show that when the microbiota adhering to the abutment are considered, rough surfaces harbour 25-times more bacteria, with a slightly lower density of coccoid organisms. But, the presence and density of subgingival periodontal pathogens are more related to the patient's dental status than to the surface characteristics of the abutments (Quirynen et al. 1993). It is interesting to note that we were able to recover high detection frequencies, both of beneficial and putative harmful micro-organisms, even on the smooth surfaces of the F2-connector. This observation justifies the validity of our plaque-sampling procedure and does not require a further detachment of adherent micro-organisms.

Although in our investigation the searched pathogens were frequently detected, they were present at low levels ranking between 2.6% (*Prevotella buccae*) and 11.4% (*P. micros*). When transformed to colony forming units (CFU), the microbial counts retrieved from the outer-surfaces of the prosthetic connector of Frialit-2-restorations were 10^3-10^4 CFU/ml on average. This coincides with the data outlined by Keller et al. (1998) where the bacterial counts from the plaque samples underneath the ITI-suprastructures varied from 10^2 to 10^5 CFU/ml. As large quantities of *Fusobacterium* spp., *Prevotella* spp. and spirochetes represent the flora of diseased peri-implant tissues (Mombelli & Lang 1998), it is reasonable that the clinical findings in our patient population group are associated with healthy conditions. *A. israelii*, *V. parvula*, *E. lentum* and *Streptococcus* spp. made up the largest proportions of the gram-positive flora. This is in accordance with previous observations of the Brånemark system where the microbiota associated with osseointegrated implants is complex, highly variable and to a large extent similar to the microflora found around natural teeth (Quirynen & Listgarten 1990; Silverstein et al. 1994).

As result of our observations, the following conclusions may be drawn: (i) The outer-surface microflora recovered from the implanto-prosthetic-connector of Frialit-2 implants reveals a colonization with gram-positive bacteria and potentially harmful gram-negative micro-organisms that were frequently detected, but present at low levels. (ii) After 2 years of restorative loading the outer-surface microbial colonization is compatible with peri-implant soft tissue health. Additional fixation or sealing procedures as recently proposed in other reports (Guindy et al. 1998; Besimo et al. 1999) might not be validated. We have to emphasize that these results can be obtained only if a professional implanto-prosthetic maintenance-care programme is provided.

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Résumé

Le but de l'étude présente a été d'examiner la microflore de la surface externe du connecteur prothéthique des implants Frialit-2 et de comparer les découvertes microbiologiques avec les paramètres paroïmplantaires deux ans après la mise en charge fonctionnelle. Chez seize patients (56±10 ans) des micro-organismes de la surface extérieure des connecteurs prothétiques ont été déterminés au niveau de 32 implants Frialit-2. La durée de mise en charge fonctionnelle des suprastructures prothétiques était de 24±14 mois. Après l'enlèvement de la restauration ancrée aux implants, des échantillons microbiens ont été obtenus des surfaces externes du connecteur prothétique Frialit-2. Les échantillons de plaque dentaire étaient identifiés sur des agars au sang CDC en tant que pourcentage de la flore cultivable totale. L'*A. actinomycetemcomitans* était déterminé semi-quantitativement sur des agars TSBV en CFU/ml. Les échantillons de plaque dentaire étaient dominés par *A.israelii* (69%), *E.lentum* (56%) et *V. parvula* (44%) avec des proportions variant entre 4 % (*V.parvula*) et 11% (*A.israelii*). Les micro-organismes Gram négatif les plus fréquemment détectés étaient le *F. nucleatum* (88%), *P. gingivalis* (81%) et *P.micros* (69 %) avec des proportions augmentées pour *P.gingivalis* (11%) et *P. micros* (11%). Aucune corrélation significative n'a pû être établie entre la microflore présente sur les surfaces externes du connecteur F2 et les paramètres paroïmplantaires examinés. La microflore à la surface externe recouvrant les connecteurs prothétiques implantaires des Frialit-2 révèle une colonisation de bactéries Gram positif et des micro-organismes Gram négatif potentiellement sans danger mais cependant fréquemment détectés à de faibles niveaux . Après deux années de mise en charge la colonisation microbienne de la surface externe reste compatible avec une santé des tissus mous paroïmplantaires.

Zusammenfassung

Analyse der Mikroflora, die von der äusseren Oberfläche des prothetischen Verbindungsstückes eines Frialit-2-Implantates gewonnen wurde.

Ziele: Ziel dieser Untersuchung war eine Analyse der Mikrobiota, die aussen auf dem Verbindungsstück anhaftet, welches zur prothetischen Versorgung von Frialit-2 Implantaten verwendet wird. Zusätzlich kam es zu einem mikrobiellen Vergleich mit den periimplantären Parametern 2 Jahre nach der funktionellen Belastung.

Material und Methoden: Bei 16 mit Implantaten versorgten Patienten (55.8±9.5 Jahre) bestimmte man die auf der äusseren Oberfläche des prothetischen Verbinders anhaftenden Mikroorganismen von 32 Frialit-2 Implantaten. Die funktionelle Belastungszeit der prothetischen Rekonstruktionen betrug durchschnittlich 24.1±13.8 Monate. Nach Entfernung der implantatgetragenen Rekonstruktion wurden mikrobiologische Proben von der äusseren Oberfläche des prothetischen Verbinders auf den Frialit-2 Implantaten entnommen. Die mikrobiologischen Plaqueproben wurden auf einer CDC-Blut-Agarplatte ausgestrichen und als total kultivierbare Flora in Prozenten angegeben. A. actinomycetemcomitans wurde semiquantitativ auf einer TSBV-Agarplatte in CFU/ml bestimmt.

Resultate: Die mikrobiologischen Proben wurden von A. israelii (68.8%), E. lentum (56.3%) und V. parvula (43.8%) dominiert, mit einer proportionalen Schwankung zwischen 3.9% (V. parvula) und 11.1% (A. israelii). Der am häufigsten entdeckte gram-negative Keim war F. nucleatum (87.5%), P. gingivalis (81.3%) und P. micros (68.8%) mit proportional erhöhten Anteilen an P. gingivalis (11.4%) und P. micros (11.4%). Man konnte keine statistisch signifikante Korrelation zwischen der auf der äusseren Oberfläche des F2-Verbinders vorhandenen Mikrobiota und den untersuchten periimplantären Parametern feststellen.

Zusammenfassung: Die Analyse der Mikrobiota, die aussen auf dem Verbindungsstück anhaftet, welches zur prothetischen Versorgung von Frialit-2 Implantaten verwendet wird, zeigte eine Kolonialisation mit gram-positiven Bakterien und möglicherweise harmlosen gram-negativen Keimen, die zwar sehr oft, aber in geringen Mengen festgestellt wurden. Zwei Jahre nach funktioneller Belastung geht die mikrobielle Kolonialisation der äusseren Oberfläche einher mit einer völligen Gesundheit der periimplantären Weichgewebe.

Resumen

Objetivos: La intención de la presente investigación fue examinar la microflora de la superficie externa de los co-

nectores prostéticos de implantes Frialit-2, y comparar los hallazgos microbianos con los parámetros periimplantarios 2 años tras la carga funcional.

Materiales y Métodos: Se determinaron en 16 pacientes tratados con implantes (55.8 ± 9.5 años) los microorganismos de los conectores prostéticos en 32 implantes Frialit-2. El tiempo de carga funcional de las supraestructuras prostéticas fue de 24.1 ± 13.8 meses de media. Tras la retirada de las restauraciones implantosoportadas, se obtuvieron muestras microbiológicas de las superficies externas del conector prostético Frialit-2. Las muestras de placa microbiana se especificaron en un CDC- agar-sangre como porcentajes de la flora cultivable total. El *A. Actinomycetemcomitans* se determinó semicuantitativamente en TSBV-agar en CFU/ml.

Resultados: Las muestras de placa microbiana estaban dominadas por *a. Israelí* (68.8%), *E. lentum* (56.3%) y *V. Párvula* (43.8%) con proporciones en el rango entre 3.9% (*V. Párvula*) y 11.1% (*A. Israelí*). Los microorganismos gram negativos mas frecuentemente detectados fueron *F. Nucleatum* (87.5%), *P. Gingivalis* (81.3%), y *P. Micros* (68.8%) con proporciones aumentadas para *P. Gingivalis* (11.4%) y *P. micros* (11.4%). No se logró establecer correlación estadísticamente significativa entre la microflora presente en las superficies externas de los conectores F-2 y los parámetros periimplantarios examinados.

Conclusiones: La microflora recuperada de la superficie externa del conector implanto-prostético de los implantes Frialit-2 revela una colonización con bacterias gram-positivas y microorganismos gram-negativos potencialmente perjudiciales que se detectaron con frecuencia, pero presente en niveles bajos. Tras 2 años de carga restaurativa la colonización microbiana de la superficie externa es compatible con tejido blando periimplantario sano.

要旨

目的：本研究の目的はFrialit-2インプラントにおいて補綴用コネクター外側表面の菌叢を検討し、機能的荷重2年後のインプラント周囲のパラメータと細菌学的所見を比較することであった。

材料と方法：インプラント治療を受けた16名の患者（55．8才±9．5才）において、Frialit-2インプラント32本の補綴用コネクターの外側表面の菌叢を測定した。上部構造の機能的荷重期間は平均24．1±13．8ヶ月であった。インプラント補綴物を撤去した後、細菌サンプルをFrialit-2 補綴用コネクターの外側表面から採取した。細菌性プラークのサンプルはCDC－血液寒天培地上で、総生菌数の％として測定した。*A.actinomycetemcomitans*はTSBV－寒天培地上でCFU/mlを準定量的に測定した。

結果：細菌性プラークのサンプルは主として*A.israelii* (68.8%) *E.lentum*(56.3%) *V.parvula* (43.8%) であり、比率は3．9％（*V.parvula*）と11．1％（*A.israelii*）の間であった。 最も高頻度に検出されたグラム陰性菌は *F.nucleatum*（87．5％） *P.gingivalis*（81．3％）及び *P.micros*（68．8％）であり、比率が高いものは *P.gingivalis*（11．4％）と *P.micros*（11、4％）であった。F2-コネクターの外側表面に存在していた菌叢と検査したインプラント周囲のパラメータの間に統計学的相関性は認められなかった。

結論：Frialit-2インプラントのインプラント－補綴物コネクター外側表面から回収した菌叢は、グラム陽性菌及び、そのレベルは低いが高頻度に検出された潜在的に有害なグラム陰性菌のコロニー化を示した。補綴物に対する荷重2年後、外側表面の細菌コロニー化の存在下で、インプラント周囲の軟組織は健康であった。

キーワード：外側表面の菌叢、インプラントと補綴物のコネクター、グラム陰性菌、インプラント周囲の条件

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