

Cure of type II diabetes mellitus by anti-infectious (step 2) periodontal therapy and the reduction of body weight

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Abstract

Type II diabetes mellitus (T2DM) is described as an inflammatory or inflammation-promoted metabolic derangement. Numerous studies demonstrate that elimination of inflammation favorably affects endocrinological parameters in T2DM. Therapy of periodontitis reduces infections of causative microorganisms and eliminates inflammation, preserving successfully treated periodontia and last but not least patients' teeth. Biofilms are reduced in quantity and influenced in composition. All facilitated by professional, as well as self-care-measures, primarily tooth-surface cleansing and oral-hygiene procedures. Thus, inflammation and affected tissues heal, finally resulting in the regeneration or professional elimination of niches and reservoirs for unfavorable microorganisms. Consequently, it is essential, to prevent infections with periodontal pathogens from flaring up, again. Such an approach is achieved with the concept of periodontal re-infection prevention (RP). Not a new method, RP has already been used successfully in classical studies, after anti-infectious as well as surgical periodontal interventions. Contrastingly, this approach of RP is largely absent from the guidelines for the treatment of periodontitis (Sanz *et al.*, 2020). With this case report, we present the course of treatment of a 60-year-old patient who was cured of his periodontitis (stage 4, grade C) and his T2DM, without any antidiabetic medication. Periodontal, endocrinological and metabolic outcomes are discussed.

Keywords: Full-mouth Decontamination, Re-infection Prevention, Periodontitis, Type II Diabetes Mellitus, Healing.

Introduction

A 60-year-old patient was referred to the department for treatment due to his periodontal screening record (PSR = 4*).

Medical history

The patient stated that he had suffered from gastric ulcers in the past, these were treated, had healed and were followed up on an outpatient basis; an umbilical hernia was present, without complaints. Furthermore, he mentioned an endoprosthetic reconstruction of his right hip joint in 2016. All treatments and follow-up examinations had so far been without complications.

At the time of the initial periodontal examination, his weight (158 kg) and height (184 cm) were measured. The resulting body mass index (BMI) was 46.7 kg/m², accounting for the diagnosis obese (class III).

The following medication schedule was provided by the patient, dating back to his hospitalization phase due to endoprosthetic surgery: Duokopt (dorzolamide, timolol eye drops 1-0-1, glaucoma), allopurinol 300 mg (1-0-0, xanthine oxidase inhibitor, uric acid reduction), valsartan dura (1-0-0, antihypertensive, vasodilation), and atorvastatin 20 mg (1-0-0, statin, a lipid-lowering remedy). These medications, except for atorvastatin that had no longer been prescribed 6 months after his first visit, remained unchanged during the observation period.

Dental history

The patient suffered from dental pain in the right maxilla, he reported to have initially received pain treatment elsewhere. He had visited his former dental care provider 3 - 4 times a year.

A manual toothbrush and different commercial dentifrices were used once a day, most likely early morning hours. No other cleaning devices, antiseptics, rinsing solutions or maintenance products were used.

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Initial periodontal screening and dental examinations 2019 (baseline, BL)

The teeth 18, 17, 15, 15, 27, 28, 38-36 and 46-48 were missing (FDI-charting). The condition of the remaining dentition and the previous loss of teeth occurred, due to significant loosening. He reported, to have kept appointments with regard to pain treatments or tooth removal.

At his BL examination, the patient had 21 teeth and no dentures. A clinical photo examination was carried out to record details of the teeth, oral tissues as well as signs of oral infections and inflammations (Fig. 1).

During a sensitivity test, it was noticed that the teeth 16, 14, 24, 25, 35, 34 and 44 did not react. Since the teeth 16 and 26 had no antagonist and 16 was clinically elongated as well as the mandibular and maxillary alveolar ridge structures had to be checked, an ortho-panoramic X-ray examination (OPT) was conducted (Fig. 2).

After patient information, instruction and initial treatment planning, further physiological parameters, i.e. height, weight and nutritional habits were assessed, followed by a puncture of his fingertip to determine an actual blood sugar level; the reader indicated a glucose concentration of 197 mg/dl. According to his own statements, he had no caloric intake at that time and only drunk some black coffee early in the morning before visiting the clinic.

X-ray findings (OPT), BL 2019 (Fig. 2)

Endodontically and restoratively incompletely treated rest dentition, 11 teeth missing. Metal-dense shadings in the regions of tooth crowns at 16, 14, 24, 25, 35 and 45 as an indication of prosthetic restorations (crowns and root-pins), less dense shadings as an indication of direct or temporary filling materials (16, 12, 26 and 45) and root canal fillings (16, 14, 25, 35, 34 and 44), radiolucency in terms of caries (13, 23 and 24) or caries



Figure 1. Clinical photo status 2019 at BL – S. J. - * 05/19/1958

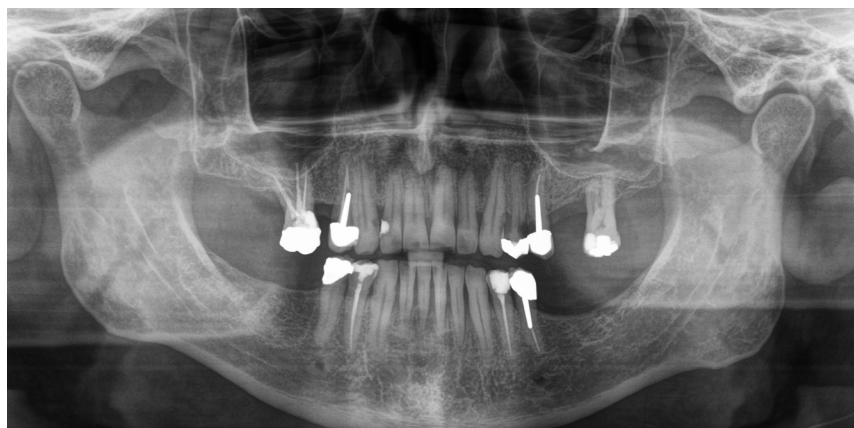


Figure 2. Ortho-panoramic X-ray examination (OPT) 2019 at BL – Patient S. J. – d.o.b. 05/19/1958

recurrences (14, 24, 25, 35 and 34), all as far as assessable from this panoramic X-ray. The relative vertical loss of the alveolar limbus in the maxilla: region 16 in the apical, 14 to 24 in the middle to coronal and at 26 in the apical third of the roots. The edentulous alveolar ridge sections dorsal to the maxillary molars showed pronounced bone loss. Relative loss of alveolar bone in the mandibular: region 35 to 32 in the middle, 31 to 42 in the apical and 43 to 44 in the coronal third of the roots.

Full periodontal examination 2019 – (BL)

Employing the FloridaProbe™ (FP) (Magnusson *et al.*, 1988), all periodontal parameters were obtained at 6 sites per tooth at any examination BL, after 6 (+6 M) and 12 months (+12 M). In the 21 teeth present at BL, pathological periodontal probing depths (Depth,

PPD) could be detected at 123 sites (98%); moderate PPD, 56 sites were between 3.5 to 5.5 mm and 67 sites with severe PPD > 5.5 mm. Recessions were evident on all teeth. Bleeding on probing (BOP) was 100%, exudations were found at 76 sites (60%). Furcation grade I could be detected at 6 sites (cf. 16 and 26). 18 teeth showed degrees of mobility up to grade III (Fig. 3).

Diagnoses

At the time of the BL examination, the periodontal diagnosis was made according to the old classification as follows: generalized severe chronic periodontitis (Lindhe *et al.*, 1999). According to current diagnostic staging and grading (Papapanou *et al.*, 2018; Tonetti *et al.*, 2018) the following and further diagnoses are evident:

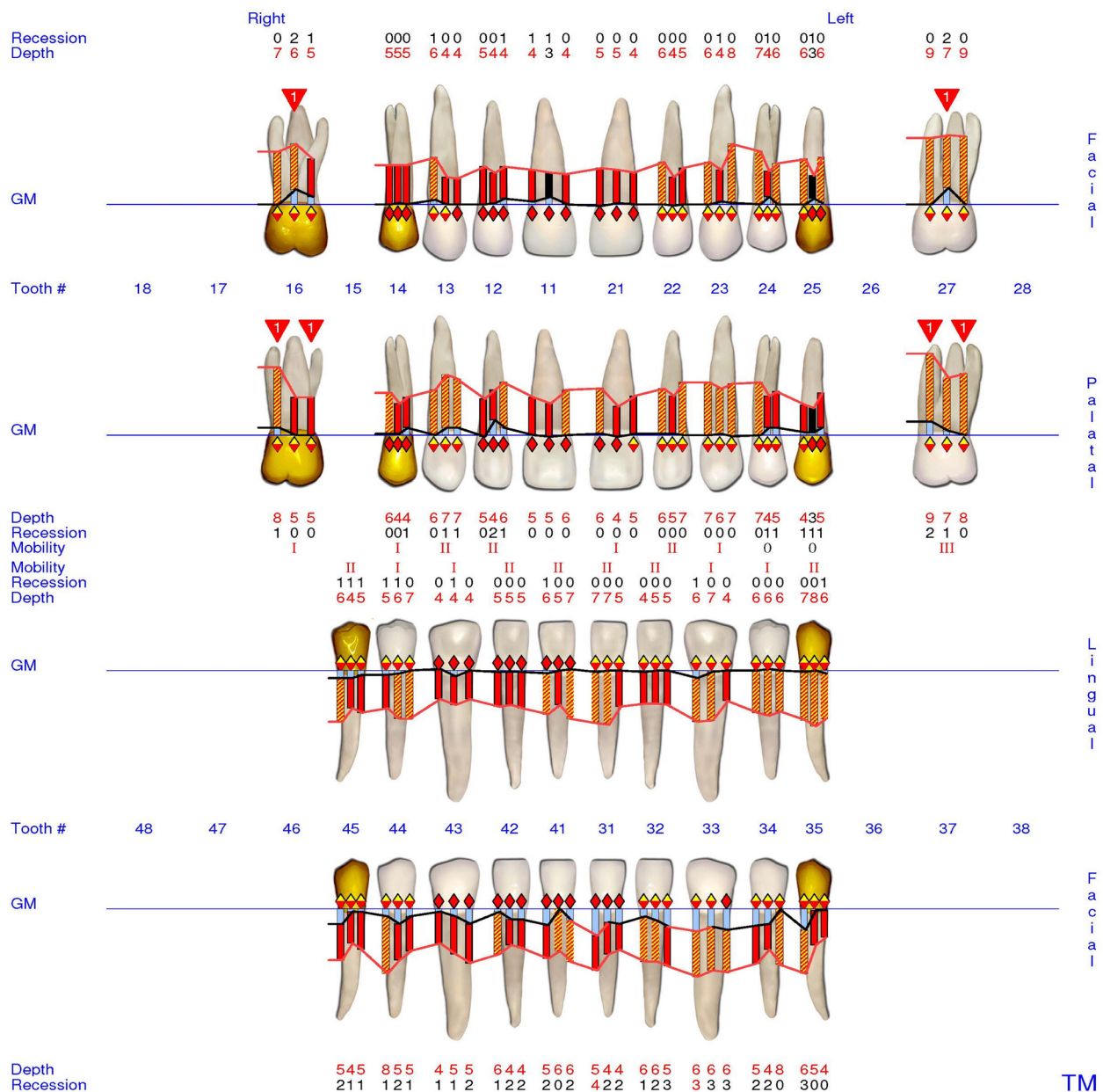


Figure 3. Full periodontal examination and recording 2019 at BL, FloridaProbe™ (Florida Probe Corporation, Gainesville, FL, USA) – S. J. - * 05/19/1958

- **Diabetes mellitus type 2 (ICD10 E11.9), naïve, i.e. 1st-time / initially diagnosed and “derailed”**
- **Periodontitis (generalized) stage IV, grade C (Jepsen et al., 2018)**
- **Apical periodontitis 16**
- **Caries or recurring caries 14, 13, 23, 24, 25, 35, and 34**

Therapeutic planning and schedule

Due to caries and necessary root canal treatments, parallel to the periodontal therapy, these rehabilitations were initiated by the colleagues of the department of restorative dentistry.

The periodontal examinations and treatments followed a stringent schedule, originating from the classical Giessen periodontal treatment concept (Herrmann *et al.*, 2012). In addition to step 1 and 2 therapies, patients receive four re-infection prevention visits (RP) pre and an additional five after the six month reevaluation (+6M) up to one year.

These sequences of RP-visits are not in accordance with the S3 guideline (Sanz *et al.*, 2020). Until the reevaluation of anti-infective treatment, no RP or supportive periodontal treatment (SPT) of any kind had been included in these guidelines. Furthermore, in the contracts with the public health plan benefit providers, to date, this supportive approach, RP, is also missing in this post-therapeutic and -diagnostic periods.

Our aims for this patient were tooth preservation, as the primary goal of periodontal, as well as restorative and endodontical therapies.

Indicated by healing and/or therapeutic elimination of periodontal pockets as well as other infection niches, the periodontium and the patient's teeth should be in a healthy, functional, aesthetically acceptable as well as pain-free condition after completing his treatments (Mombelli *et al.*, 2014; Hirschfeld *et al.*, 1978; Herrmann and Sonnenschein, 2012).

Full mouth decontamination (FMDC) – more than the combination of therapy steps I and II (Sanz et al., 2020)

After the BL periodontal examination, microbiological diagnostics and resistance determination (Fig. 4), a full-mouth-decontamination (FMDC) was carried out in only one visit with the aim of achieving maximum biofilm reduction by cleaning all teeth, hard tissues/surfaces and oral mucosae; furthermore to avoid systemic side effects (Quirynen *et al.*, 2000; Graziani *et al.*, 2015). This concept at the Justus-Liebig University at Giessen is an extension of the full-mouth-disinfection (FMD) introduced by Quirynen (Quirynen *et al.*, 1995; Vandekerckhove *et al.*, 1996) and modified by Saxer (Saxer *et al.*, 2007). Peri-therapeutic administration of antibiotics are prescribed after microbial sampling, ex

vivo plating, cultivations and antibiotic resistance determinations (Fig. 4). Exceeding the standard prescription for severe periodontitis cases with more than 35% sites with probing depths ≥ 5 mm, the hereby determined antibiotic medication proved beneficial as recommended by literature.

Due to the individualized antibiotic prescriptions, the Giessen concept of FMDC extends the use of antiseptics compared to classical FMD without systemic medication. Furthermore, chlorhexidine digluconate was completely omitted. The alternatively used povidone-iodine (B. Braun™ Melsungen AG, Melsungen, Germany) demands more frequent use due to the lower substantivity, during, as well as after the FMDC, in extended usage periods and higher application frequencies (Tsobgny-Tsague *et al.*, 2018; Saxer *et al.*, 2007).

The antibiotic dosage based on resistance determinations (Fig. 4) was further adjusted to the present patient's weight and BMI. He was instructed to start taking amoxicillin 875 mg including clavulanic acid 125 mg three times a day, one day before FMDC and to continue for nine more days. The patient reported no side effects.

The supra- and subgingival instrumentation in the context of FMDC was performed under a combined use of mechanical instruments:

Airscaler KaVo™ Dental GmbH, Biberach, Germany; erythritol powder (Airflow Powder Plus) and Airflow, EMS™ / Electro Medical Systems S.A., Nyon, Switzerland; povidone-iodine ultrasound with the Odontogain, XO Care™ A/S, Hørsholm/Denmark) and scaling and root planing with hand instruments (Gracey curettes, scalers, probes and explorers, Hu-Friedy™ Mfg. Co., LLC, Chicago/IL, USA).

All supra- and subgingival cleansing, planing, polishing local disinfecting was carried out in one session, critically controlled, both, clinically (explorers) and radiographically (Fig. 5). Furthermore, in this visit, all oral soft tissues and periodontal pockets/niches including (pharyngeal) tonsils were repeatedly rinsed and/or swiped (cotton swops) with povidone-iodine (i.e. before, during and, after the procedure, and another three times. Irrigations were performed with 3 ml Luer-lock syringes with (unsharpened) endo needles (VMK™-EndoNeedle, 0.35 x 25 mm, Luer), all pocket entrances and gingival sulci were professionally rinsed. In case of furcation lesions, povidone ointment (100mg/g) was also applied to the adjacent periodontal pocket (Miraject™ 0.9 x 22 mm, Luer).

The performance of the patient in oral hygiene procedure (interproximal brushes, floss, tooth brush) were controlled and optimized accounting for his personal skills. Pocket and furcation irrigation-techniques were explained, demonstrated and practiced repeatedly, until he was able to perform all instillation and hygiene measures independently, with the goal of a long-term re-infection prevention continuing over the healing phase.

This combination of procedures, FMDC and professionally controlled as well as home-based preventive measures are intended to reduce bacterial loads continuously. The risk of re-infection after the single-step

treatment of periodontitis should remain permanently low. This supervised environment during RP contributed to foster the patient's participation and adherence.

CFUs >

CFUs >

					Antibiotic resistance versus...											
No.	1.E+03	1.E+04	1.E+05	1.E+06	Genera / Species	Result	Description	No.	amoxicillin	ampicillin / sulbactam	amoxicillin / clavulanic acid	doxycycline	ciprofloxacin	clindamycin	azithromycin	metronidazole
1					<i>Aggregatibacter actinomycetemcomitans</i>	-	not detected	1								
2					<i>Treponema denticola</i>	+	masses	2	S	S	S	S		S	S	S
3					<i>Porphyromonas gingivalis</i>	+	masses	3	S	S	S	S		S	S	S
4					<i>Tannerella forsythia</i>	+	masses	4	S	S	S	S		S	S	S
5					<i>Prevotella intermedia / nigrescens</i>	+	masses	5	S	S	S	S		S	S	S
6					<i>Campylobacter</i> spp.	+	masses	6	S	S	S	S	R	S	S	S
7					<i>Fusobacterium</i> spp.	+	masses	7	S	S	S	S	S	S	S	S
8					<i>Peptostreptococcus micros</i>	+	abundant	8	S	S	S	S		S	S	S
9					<i>Eubacterium nodatum</i>	+	abundant	9	S	S	S	S		S	S	S
10					<i>Eikenella corrodens</i>	+	masses	10	S	S	S	S	S	R	S	R
11					<i>Capnocytophaga</i> spp.	+	masses	11	S	S	S	S	S	R	S	R
12					<i>Prevotella</i> spp.	-	not detected	12								
13					<i>Prevotella melaninogenica</i>	-	not detected	13								
14					<i>Bacteroides</i> spp.	+	abundant	14	S	S	S	S	R	S	S	S
15					<i>Actinomyces odontolyticus</i>	-	not detected	15								
16					<i>Actinomyces</i> spp.	+	masses	16	S	S	S	S	R	S	S	R
17					<i>Veillonella</i> spp.	-	not detected	17								
18					<i>Streptococci</i> spp. (non hemolytic)	+	masses	18								
19					<i>Neisseria</i> spp.	+	masses	19								
20					<i>Acinetobater baumannii</i>	-	not detected	20								
21					<i>Enterobacter cloacae</i>	+	masses	21								
22					<i>Klebsiella oxytca</i>	-	not detected	22								
23					<i>Candida albicans</i>	-	not detected	23								
24					other yeasts (candida / crytrococci spp. and other)	-	not detected	24								

= *Agg. actinomycetemcomitans*

= red complex

= orange complex

= further complex associated microbiota

= *Actinomyces* spp.

= common oral microbiota

= superinfection of the microbial culture

R = resistant

S = susceptible

Italics = susceptibility and resistance according to the literature

Figure 4. Record of the microbial sampling, cultivation and resistance determination 2019 at BL – S. J. - * 05/19/1958

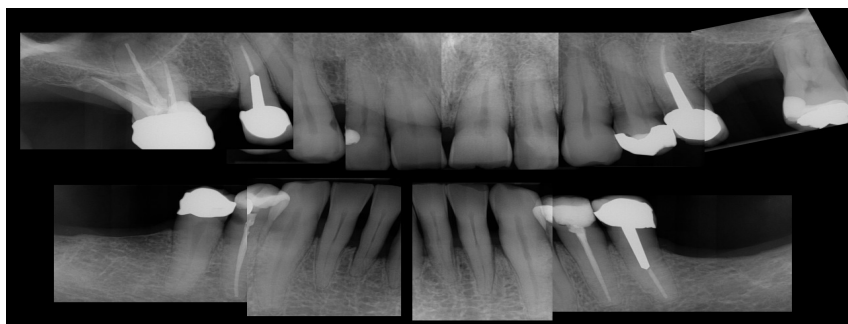


Figure 5. Intraoral X-ray examinations, mounted. Periodontal reevaluation, cariologic and endodontic diagnostics – S. J. - * 05/19/1958 2019 (FMDC +6 month)

Systemic parameters during the observational phase (Table 1)

The patient was completely unaware of his diabetic condition, revealed by our first diagnostic session, the blood sugar screening after the PSR.

The succeeding and detailed systemic BL examinations confirmed his medical condition. Furthermore, until that date, his primary care provider had not recorded his type II diabetes mellitus.

The phase in-between FMDC up to the periodontal reevaluation

As an alternative to the therapeutic recommendations in the guidelines (Sanz *et al.*, 2020), an examination at three months after anti-infectious treatment, the reevaluation was carried out after six months.

It should be noted that four active RP appointments were offered up to this examination. These sessions included oral hygiene checks, supragingival cleansing, (re-) motivations, (re-) instruction. The patient's oral hygiene techniques were reviewed and discussed. All of his cleaning procedures were controlled and/or (re-) adapted. The use of antiseptics for gingival crevicular irrigation was evaluated and modified for his personal needs. Thus, after the elimination of a massive, disbiotic

biofilm (Figs. 1 vs. 6) as well as supra- and subgingival calculus, (exogenous) deposits and stains by means of FMDC in combination with re-infection prevention, the patient continued to exercise and optimize his oral hygiene protocols (Fig. 8).

Periodontal reevaluation (FMDC + 6 M).

Up to this visit, all 21 teeth of the patient could be preserved. There was a significant reduction in probing depth at all 126 measuring points (cf. green and black arrows, respectively, Fig. 7). Periodontal pockets ≥ 3.5 mm no longer occurred. Exudation and BOP probing were absent. Recessions were noted on all teeth, 18 of these were > 3 mm. The patient still had 5 furcations, four grade I and one grade II. Palpable mobility (grad I) was present on eight teeth.

Clinically, a healthy gingiva could be observed, exhibiting regular stippling; papillary bleeding could not be provoked with a blunt probe tip (XP3A/NC156, Hu-Friedy™ Mfg. Co., LLC, Chicago/IL, USA). In the treatment course, the patient was photographed at the time of reevaluation (FMDC +6 M) (Fig. 6); his last professional tooth cleaning during RP, i.e. before taking these pictures at FMDC + 6 M, dated back 6 weeks.

Table 1. Hematological, endocrinological parameters and findings of physical examinations.

Parameters	[units]	reference ranges	BL	FMDC +14 D	+6 M	+12M
ESR	[mm / 1 st h]	≤ 20	27	22	9	4
FPG	[mg / dl]	30-110	197	120	103	89
t-CHOL	[mg / dl]	120-220	255	161	185	127
TRIG	[mg / dl]	30-245	205	131	141	147
HDL	[mg / dl]	40-80	315	37	45	46
LDL	[mg / dl]	65-150	134	104	119	75
hs-CRP	[mg / l]	0-1.0	2.2	1.0	0.9	<0.5
Leuko. count	[giga / l]	3.9-28.2	6.9	6.5	5.6	6.1
HbA _{1c}	[%]	4.0-6.3	7.9	7.4	6.8	6.2
INS	[μ U / ml]	3.0-25.0	28.4	19.3	17.6	13.0
C-PEP	[ng / ml]	0.9-4.0	4.58	4.22	3.05	3.51
height	[m]		1.84	1.84	1.84	1.84
weight	[kg]		158	153	133	129
BMI	[kg / m ²]		46.7	41.9	39.3	38.4

Systemic examinations were performed at four time points, at baseline (BL), 14 days after full-mouth decontamination (FMDC +14 D), after another 6 months (+6 M), and after 12 months (+12 M).

Age- and gender-specific reference values (cf. reference ranges) are depicted after the metric [units] entries for respective hematological or endocrinological parameters.

Bold indicates increased, **bold and italic** corresponds to decreased values.

obese (grade III), **obese (grade II)**, **obese (grade I)**, **overweight**

ESR, erythrocyte sedimentation rate; FPG, fasting plasma glucose; t-CHOL, total cholesterol; TRIG, triglycerides; HDL, high density lipoproteins; LDL, low density lipoproteins; hs-CRP, high-sensitive c-reactive protein; Leuko. Count, total leukocyte count; HbA_{1c}, glycosylated hemoglobin; INS, insulin; C-PEP, c-peptide

Data not shown: when calculated, these (and follow-up) *INS/C-PEP-ratios* of this patient were far below 1.0, supporting the anamnestic notion that no parenteral antidiabetic administrations (i.e. INS) were used.



Figure 6. Clinical photos at the time of the periodontal reevaluation 2019, + 6 month after FMDC - S. J. - * 05/19/1958

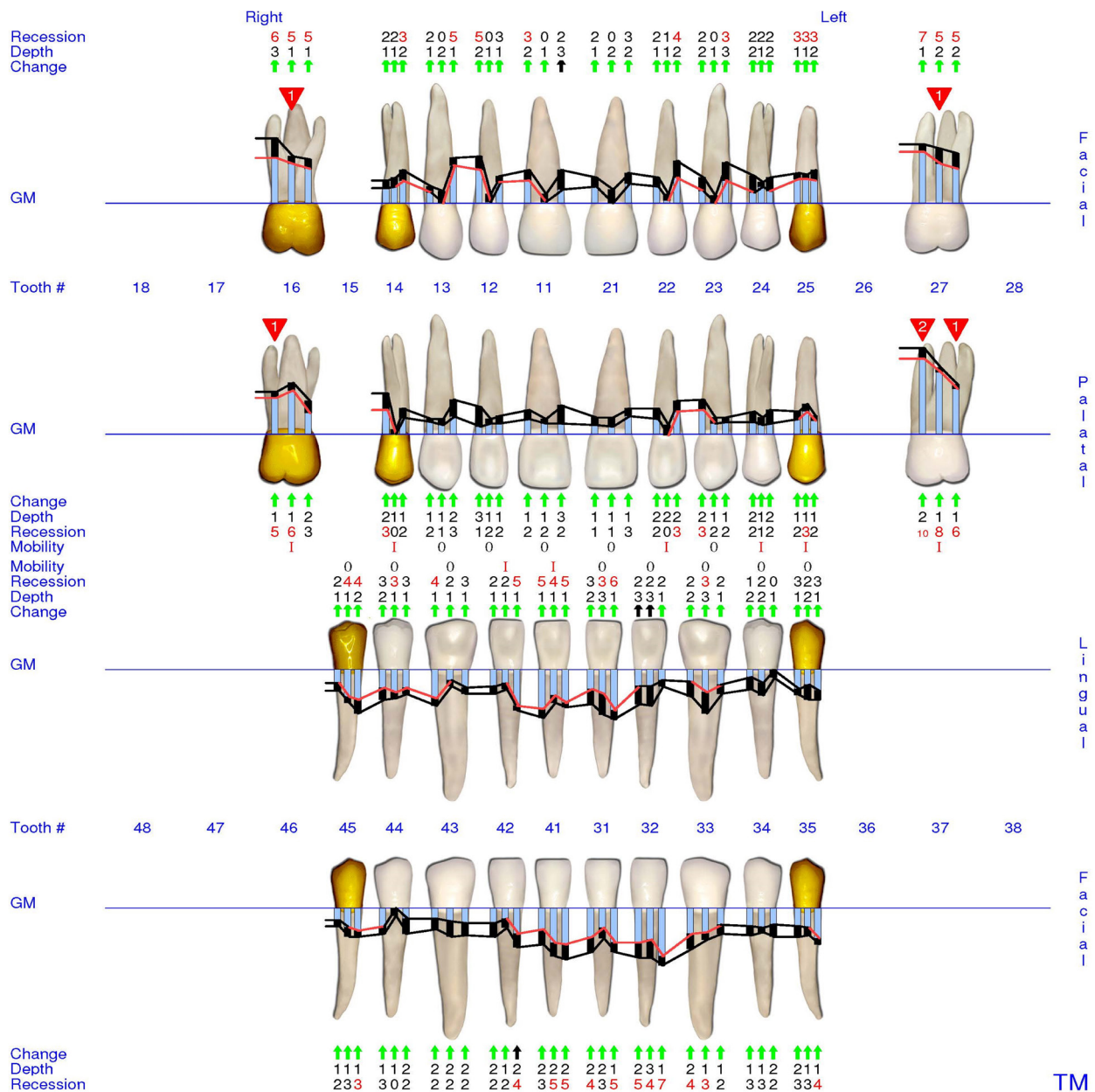


Figure 7. Full periodontal reevaluation and recording 2019, + 6 month after the FMDC, FloridaProbe™ (Florida Probe Corporation, Gainesville, FL, USA) - S. J. - * 05/19/1958

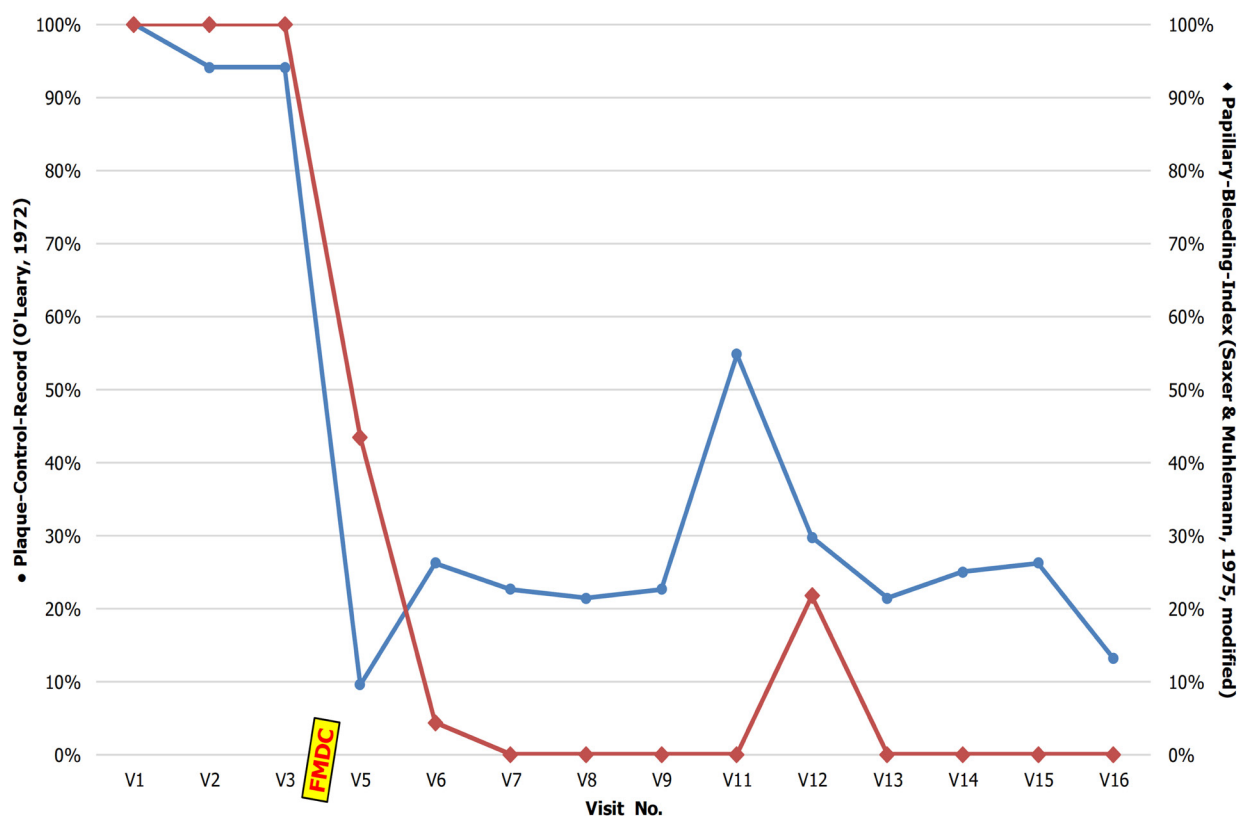


Figure 8. Oral hygiene parameters, modified papillary-bleeding (Saxer and Muhlemann, 1975) and plaque (O'Leary *et al.*, 1972) indices.

Oral Hygiene

The oral hygiene diagram displays modified papillary-bleeding (Saxer *et al.*, 1975) and plaque (O'Leary *et al.*, 1972) indices over the complete observational phase (BL to +12 month) (Fig. 8).

Interestingly, the initial 3 recordings (pre FMDC), including personalized (re-)recommendations/-instructions did not lead to any notable reduction of oral hygiene parameters. The patient stated, “not to be able to care more for his teeth”, while both indices reached still approx. 100%.

After FMDC and the elimination of periodontal infection and inflammation, the presence of substrates that favor the growth of proteolytic bacteria is minimized. Thus, biofilm (re-)growth rate and quantity were reduced as well as quality symbiotically normalized (van der Velden, 2006; Ramberg *et al.*, 1995; Tonetti *et al.*, 2007) (Fig. 8).

Conversely, both hygiene indices plummeted after FMDC. Note, the patient continued to clean as before, i.e. self-reported, he did not change the mode, nor the frequency or time he spend for his oral maintenance at home. These oral hygiene parameter changes reciprocally support the hypothesis that periodontal inflammation favors regrowth of biofilms (van der Velden, 2006; Ramberg *et al.*, 1995).

Final periodontal evaluation, 12 months after FMDC

The tooth-preserving, cariological-endodontic rehabilitation measures had not been completed by this time. The patient therefore continued to be under the care of colleagues in the Department of Restorative Dentistry.

One year after the FMDC all initially present teeth had been preserved. Periodontal pockets were no longer present at any of the 126 sites assessed; none of them lost attachment during RP. Exudation and bleeding on probing were at 0%. 9 teeth showed recession, all were > 3 mm. The patient continued to have 5 grade I furcations. Mobility grad I was notable on six teeth (Fig. 9).

Clinically, the gingiva was healthy, with regular stippling; papillary bleeding was not elicitable after provocation with a blunt probe (PCPUNC-15, Hu-Friedy) (modif. PBI (Saxer and Muhlemann, 1975)). In the clinical follow-up documentation, the patient was photographed at FMDC +12 months (Fig. 10). The microbial assessment performed after 12 months showed a clear shift away from a disbiotic biofilm, although *Porphyromonas gingivalis* remained under the threshold for an systemic antibiotic intervention (Fig. 11, cf. line 3).

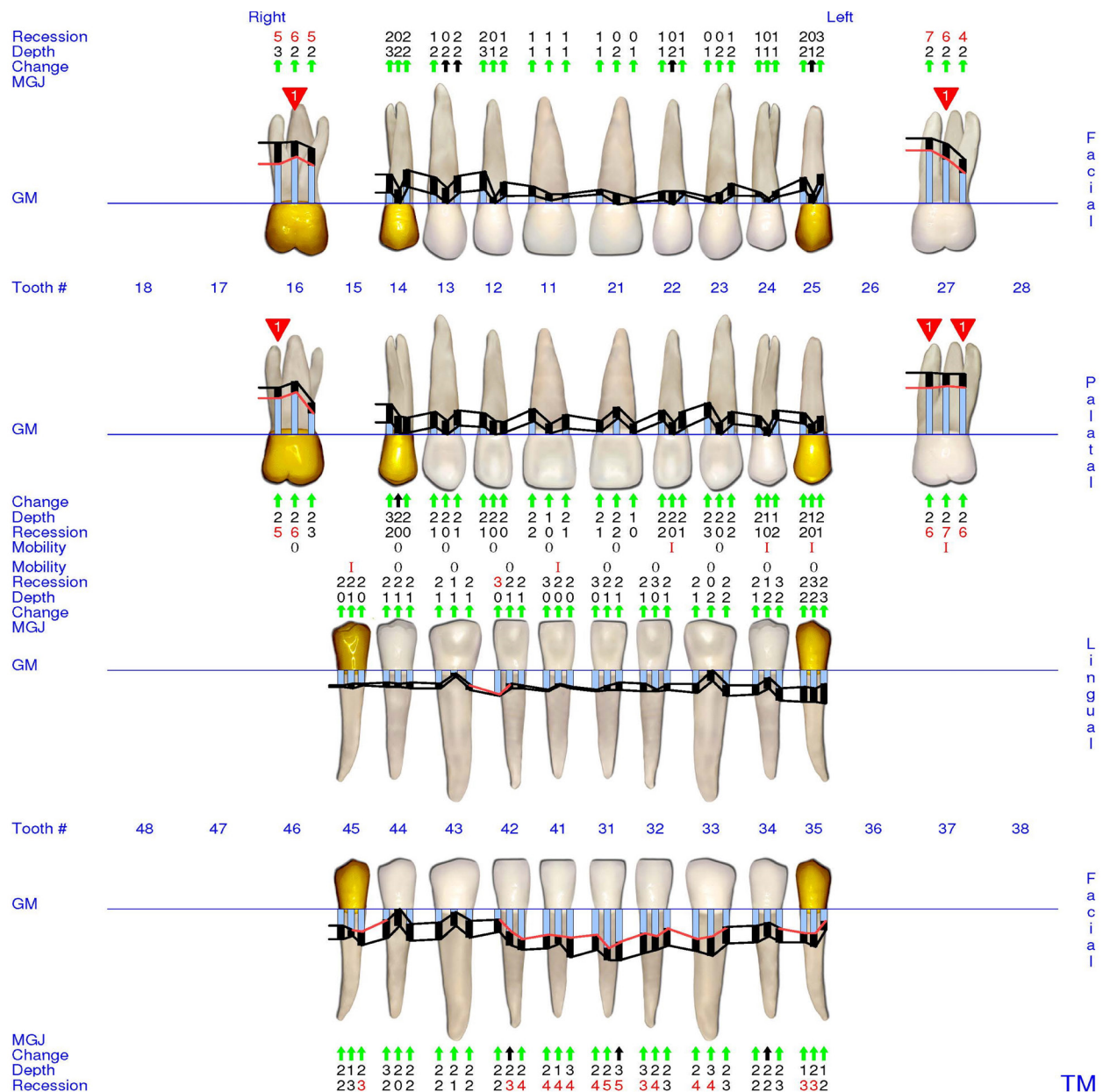
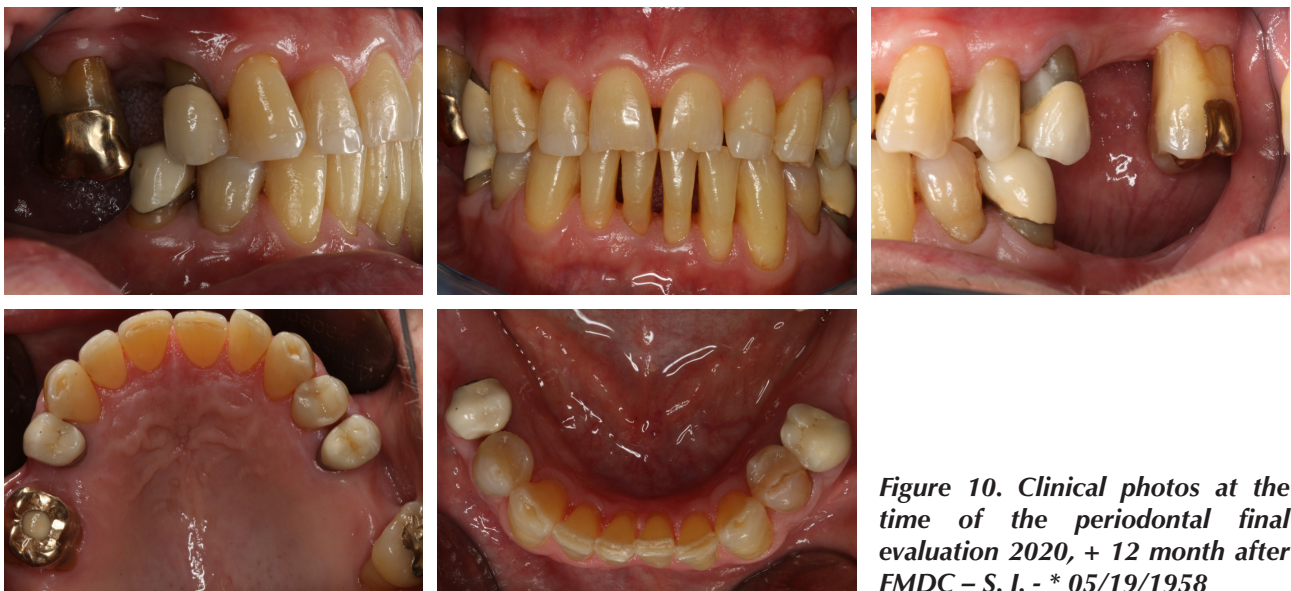


Figure 9. Final periodontal evaluation and recording 2020, + 12 month after the FMDC, FloridaProbe™ (Florida Probe Corporation, Gainesville, FL, USA) – S. J. - * 05/19/1958



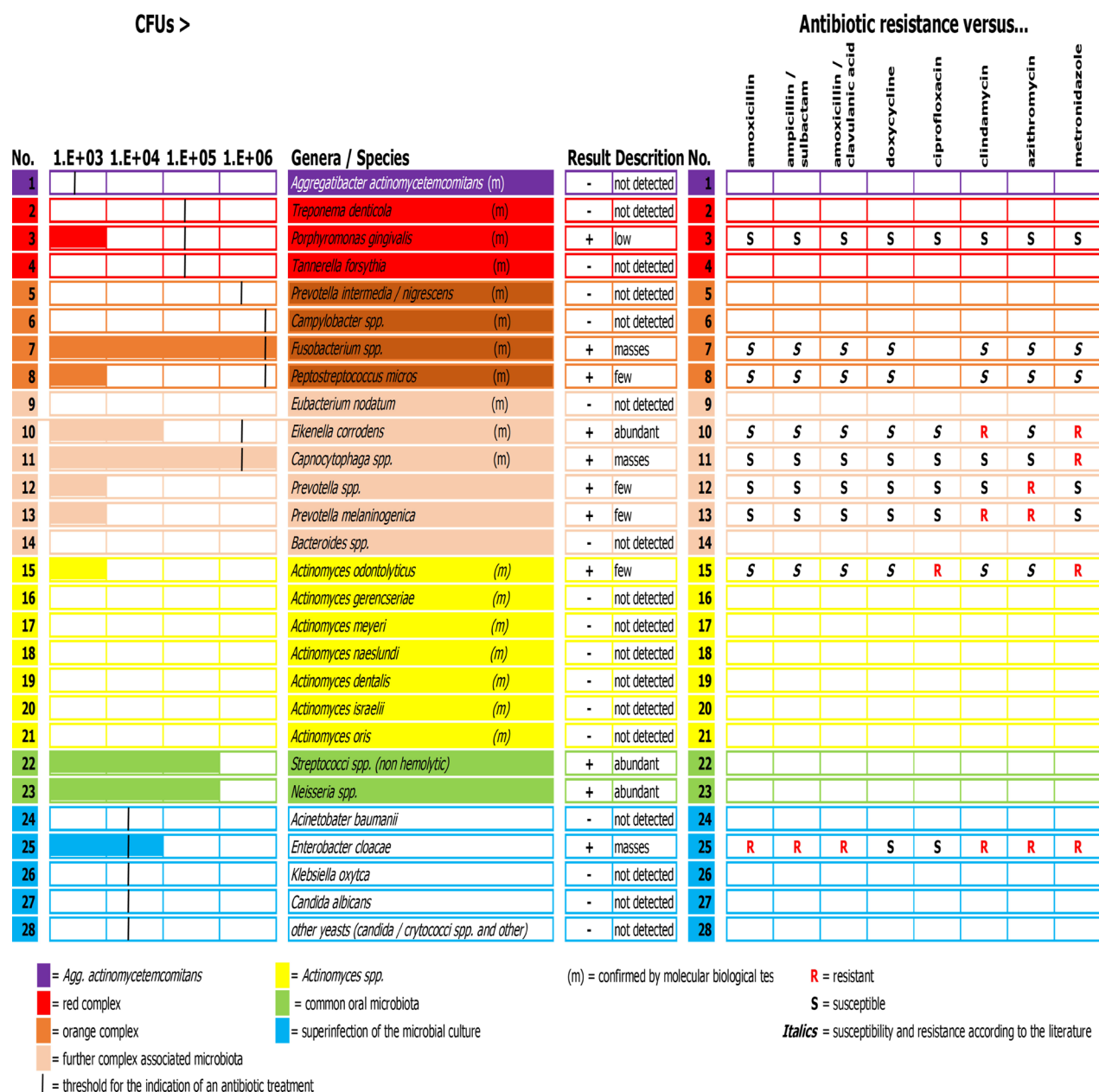


Figure 11. Record of the follow-up microbial sampling, cultivation and resistance determination 2020, +12 month after the FMDC – S. J. - * 05/19/1958 (details cf. above)

However, a clinical asymptomatic infection with *Enterobacter cloacae* was conspicuous (cf. line 25). Thus, the patient had been referred to the department of gastroenterology where he was followed-up due to his former gastric ulcers and now, the antibiotic resistance of this particular organism. There it was hypothesized that this infection could be due to an exposure at his work in the hospital environment. Nevertheless, this infection was neither confirmed, nor did it reoccur.

His attention was not only focused on his teeth but also on his general well-being, as his systemic health improved significantly over the course of treatment. Not only did the systemic inflammatory parameters (hs-CRP and ESR) decrease to normal values, but also endocrinological findings (fasting blood glucose, glycated hemoglobin,

blood lipids, c-peptide and insulin) decreased and reached their corresponding normal values at the time of reevaluation after 6 months and remained under control by the time of the final periodontal evaluation (12 months).

At the end of the treatment, re-infection prevention and examination phases, his diagnose no longer corresponded with the criteria for type 2 diabetes mellitus as had been determined at the beginning of treatment.

According to his statements in the final interview, he placed more emphasis on his body awareness. His significant weight reduction was an expression of this motivation, which drives him to exercise activities, gymnastics and sports. In this way, the patient's agility and drive were promoted, with an overall increase in his self-esteem.

Discussion

According to classical studies, the initial 3 months after active treatment are particularly critical for periodontal healing (Badersten *et al.*, 1984a; Badersten *et al.*, 1984b; Renvert *et al.*, 1981). Mature recolonization of tooth surfaces by bacteria occur within one to two weeks (Quirynen *et al.*, 2005; L  e *et al.*, 1965). A neo-genesis as well as persistence of disbiotic biofilms should be prevented. In the case presented, re-infection prevention (RP), consisted of professional oral hygiene (re-) instructions and biofilm removal, if any stain or calculus (re-) build-up should have occurred in the presented, well-trained and adherent patient.

RP at a 2-week interval over 2 years had been evaluated, particularly after surgical periodontal therapy in Lindhe's group (Nyman *et al.*, 1975; Rosling *et al.*, 1976). RP intervals between 2 and 12 weeks (Westfelt *et al.*, 1983) have also been considered and were studied. The concept with the shortest (i.e. two weeks) RP interval, beginning right after active treatment, was clearly superior, elucidated by periodontal parameters such as the reduction of probing depth or the bleeding on probing.

Against a cost-benefit background, individual patient adherence should be taken into account as a factor, influencing the frequency of re-infection prevention. The important application of oral hygiene at home, maintenance products and preparations, in combination with the performed pocket irrigations with antiseptics, requires individual training, (re-)information, (re-)instruction and supervision, depending on the abilities of an individual patient. The concept presented involves measures and scheduling sequences that are not described in the S3 guidelines or in the public health insurance program in our country.

Howbeit, at the reevaluation examination (FMDC +6 M), our patient exhibited no indication for periodontal surgical therapy (i.e. resective surgery / pocket elimination, regeneration, etc.). According to our concept, RP visits were continued for another six month until the annual periodontal examination.

A comparative overview between clinical initial versus final images as well as PISA findings (Nesse *et al.*, 2008) can be seen as an indicator for the healing of periodontitis (Fig. 12), confirmed by the final periodontal examination (Fig. 9).

The success in this case can be attributed to an integrated tooth-preserving treatment concept. After joint planning with, the systematic periodontal therapy was accompanied by numerous filling restorations and root

canal treatments on the part of the department of restorative dentistry. This examination after 12 months yields the diagnoses: gingival and periodontal health in a reduced periodontium (Chapple *et al.*, 2018).

This is by no means the fulfillment of the integrated treatment, nor a complete rehabilitation of the oral conditions. Because of his initial diagnose (BL) and risk, the patient was scheduled for an additional four supportive periodontal therapy (SPT) sessions during the first year after the described observation phase. This SPT-frequency would allow for 2 more appointments in the 3rd and last year, covered by the health plan. It remains to be seen whether this frequency is sufficient to ensure long-term treatment success in this healed and recovered, but formerly severely ill patient.

In addition, the BL-examinations performed in the Department of Periodontology provided the diagnosis of diabetes mellitus type II. The development, severity and resistance to therapy of this metabolic disease is significantly favored by inflammation such as periodontitis (Genco *et al.*, 2020b; Genco *et al.*, 2020a; Polak *et al.*, 2020). Although interactions and mutual therapeutic influence have been controversially discussed (Madianos *et al.*, 2018; Engebretson *et al.*, 2013; Sonnenschein *et al.*, 2015), the elimination of local and systemic inflammation should also stand as a treatment goal in diabetic patients.

Due to all measures of local therapy, re-infection prevention, motivation, instruction and education, this patient not only experienced healing of his periodontal disease, but in addition, developed a positive change in self-perception, which extended beyond the well-being of his oral cavity. Noteworthy, despite a freshly diagnosed, initially derailed diabetes mellitus type II (HbA_{1c} 7.9%, fasting BG 197 mg/dl), it was not necessary for him, to use (par-)enteral, antidiabetic medication within the entire observation period.

The patient rewarded us with a smile, even though implantological and prosthetic measures are pending (Fig. 13).

He has great interest in further reducing his body weight (Fig. 14) and is currently considering increasing his physical fitness through swimming and swimming-pool based exercises.

His efforts to implement oral hygiene at home, following detailed instructions have been above average. If his periodontal evaluations remain stable, an indication for implantological and/or prosthodontic rehabilitation measures that go beyond interim fillings and replacements is indicated.

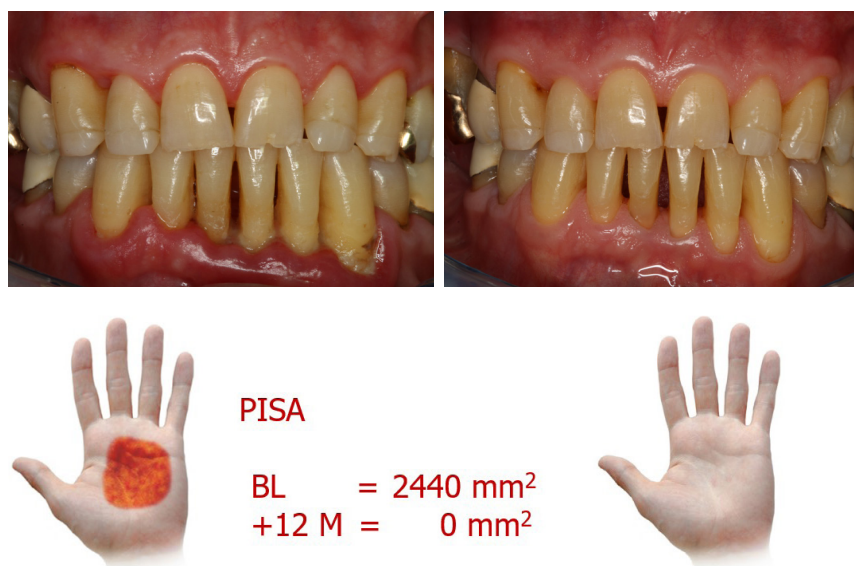


Figure 12. Baseline versus final periodontal evaluation (BL / FMDC +12 month), a comparison of the periodontal inflamed surface area (PISA), metric unit in square mm [mm²] and illustrated as relative palm surface area (Nesse et al., 2008).



Figure 13. Extra-oral photo 3 – Despite his knowledge that complete oral and physical wellbeing will need further efforts; he expressed his gratitude by a smile.



Figure 14. Extra-oral photo 2 – The patient glad and delighted, to have recovered from periodontitis and type 2 diabetes mellitus. He has chosen and aims to adhere to a healthy lifestyle and signed up for professional supervision.

An outlook for residents, colleagues and physicians

As illustrated by this case report, mutually influencing diseases such as type 2 diabetes mellitus and periodontitis can be brought into remission by appropriate and consistent diagnostics, planning, treatment, instruction and motivation.

Furthermore, highlighted in orange (Fig. 15), and applied in the periodontal therapy of the presented and further patients of our department, we suggest the

addition of re-infection prevention (RP) to the treatment steps in the protocol by Sanz *et al.* (Sanz *et al.*, 2020).

Interestingly, diabetes-related medical intervention was not necessary for this patient.

Therefore, thorough and detailed communications in the triangular relationship between patients, physicians and dentists with coordination of examinations and treatments is the key to successful therapy and the basis for healing and recovery.

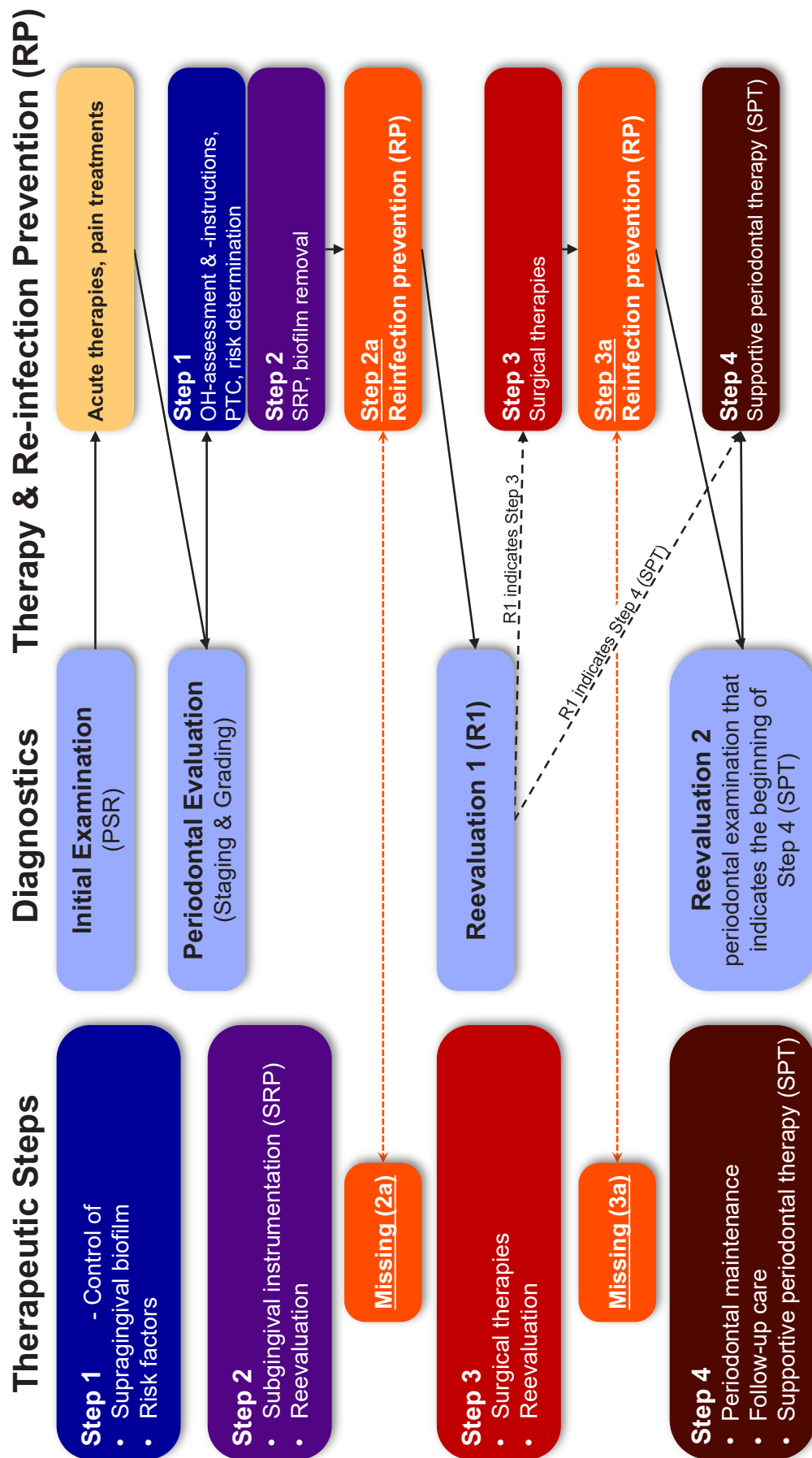


Figure 15. Therapeutic steps according to Sanz. (Sanz et al. 2020) – We strongly suggest the implementation of re-infection prevention (RP) into this concept (cf. Steps 2a and 3a, orange).

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