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Evidence for healing of intrabony and furcation defects after periodontal therapy: digital subtraction and bone measurements

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Objective

Comparison of digital subtraction analysis to the gold standard of intrasurgical measurements 5 years after periodontal surgery of intrabony and furcation defects.

Material and Methods

Patients

- 13 patients (8 female) 32 - 64 years of age.
- Untreated advanced periodontal disease.
- Each exhibiting at least one interproximal intrabony and/or class II/III furcation defect.

Radiographic examinations

- Standardized bitewing radiographs of teeth with intrabony/class II/III furcation defects using modified film holders (VIP 2 Film Positioning, UpRad Corp., Fort Lauderdale, FL, USA) (Fig. 1, 2) at baseline, 6, and 60+3 months after surgery. Two orthodontic wires were placed on the mandibular side of the filmholder at a specified position (Fig. 1). Shadows of these wires were cast onto the radiographs. From the distances between the images of these wires on a radiograph, the vertical and horizontal angulation difference between the consecutive radiographs could be calculated.
- Intraoral dental films (Ultraspeed, Eastman Kodak Co., Rochester, NY, USA) size 2.
- x-ray source (Heliodent 70, 70 kV, 7 mA, Siemens, Bensheim, Germany).
- Development unit (Periomat, Dürr Dental GmbH, Bietigheim-Bissingen, Germany).

Fig. 1:
Modified
filmholders.



Fig. 2: Modified filmholder
with aiming device.

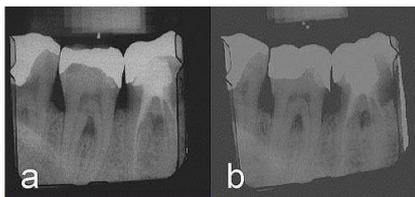


Fig. 3: Radiograph of
class II furcation defects
(first and second
right mandibular molars)
at baseline (a), 60
months after GTR
therapy (b), and subtraction
image (c).

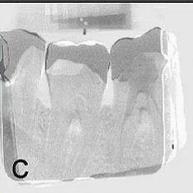


Fig. 4:
Radiograph of
intrabony defect
(first left mandibular
molar) at baseline (a), 6
months after
GTR therapy (b), area gain
marked (c) and
subtraction image (d).



Clinical examinations

At 6 sites per tooth (baseline, 6, 60+3 months after surgery):

- Gingival Index (GI) and Plaque Index (PII).
- PD and CAL-V to the nearest 0.5 mm (PCPUNC 15).
- CAL-H to the nearest 0.5 mm in class II furcations (PQ2N).

Periodontal surgery

- Mucoperiosteal flap, thorough debridement alone in 5 defects and GTR in 25 defects using ePTFE (14 defects) and Polyglactin 910 (11 defects) barriers.
- Removal of ePTFE barrier after 4 to 6 weeks.

Bone measurements

After reflection of a full thickness flap and under local anaesthesia 60+3 months after surgery:

- Distance cemento-enamel junction (CEJ) to the most apical extension of the bony defect (BD): PBL-V.
- Horizontal probing bone level in class II furcations: PBL-H.

Radiographic evaluation

Measurements using a loupe of 10 fold magnification and a 0.1 mm grid (Scale loupe 10, Peak, Tohkai Sangyo, Tokyo, Japan):

- Distances between the projections of the orthodontic wires that had been fixed to the filmholders vertically (dv) and horizontally (dh) on every radiograph.
- Capturing of each radiograph with a CCD camera: Cohu Solid State Camera, Cohu Inc., San Diego, CA.
- All radiographs were analysed by one examiner blinded to the clinical and intrasurgical measurements (EH).

Statistical analysis

- Kolmogorov-Smirnov/Lilliefors-Test for normal distribution.
- Comparison of baseline to 6 and 60 months postsurgical measurements by paired t test.
- Stepwise multiple linear regression analysis:
dependent variable: PBL-V, PBL-H
explanatory variables: baseline PBL-V/-H, subtraction parameters, GTR therapy, patient.
- Simple regression analysis:
relative density loss/PBL-V, net area change/PBL-H

Results

Results					
Tab. 1: Clinical parameters (mean±SD)					
	GI	PII	PD/mm	CAL-V/mm	CAL-H/mm
Baseline	1.9±0.4	0.9±1.0	5.9±1.5	6.4±1.9	4.8±0.8
6 months	0.7±1.0	0.5±0.8	3.2±0.8	4.8±1.3	3.0±1.0
Change	-1.1±1.1	-0.3±1.1	-2.7±1.2	1.6±1.2**	1.8±0.8**
60 months	0.8±1.0	0.7±0.9	4.0±1.4	5.2±1.8	3.0±1.3
Change	-0.9±1.2	-0.1±1.5	-1.9±1.6	1.2±1.9**	1.8±1.0**

Tab.2: Bone parameters (mean±SD)				
	PBL-V /mm	rel. density loss	PBL-H /mm	net area change
Baseline	6.4±1.5		4.5±0.8	
60 months	5.9±1.8		3.5±1.1	
Change	0.5±1.8	7.8±13.0	1.0±1.1*	0.7±1.3

Tab. 3: Stepwise multiple linear regression analysis:

Dep. variable: PBL-V gain/mm (60 months); n = 30;

$R^2 = 0.93$; $R^2_{\text{adjusted}} = 0.90$; s.e.(estimate) = 0.58

	<i>b</i>	s.e.(<i>b</i>)	β	<i>p</i>	
Constant	-1.340	0.751		0.091	
Baseline PBL-V	0.342	0.094	0.846	0.002	
Relative density loss	0.048	0.010	0.841	0.000	
GTR therapy	0.666	0.341	0.852	0.067	
Patient 1	-1.975	0.617	0.922	0.005	
Patient 3	1.064	0.449	0.904	0.029	
Patient 6	-5.131	0.458	0.868	0.000	
Patient 12	-1.136	0.442	0.933	0.019	
Patient 13	-1.213	0.444	0.924	0.014	
Analysis of variance					
Source	SSQ	DF	MSQ	<i>F</i> -ratio	<i>p</i>
Regression	85.087	8	10.636	31.488	0.000
Residual	6.080	21	0.338		

Tab. 4: Stepwise multiple linear regression analysis:

Dep. variable: PBL-H gain/mm (60 months); n = 18;

$R^2 = 0.52$; $R^2_{\text{adjusted}} = 0.46$; s.e.(estimate) = 0.82

	<i>b</i>	s.e.(<i>b</i>)	β	<i>p</i>	
Constant	0.480	0.233		0.057	
Net area change	0.408	0.157	0.947	0.020	
Patient 8	1.282	0.532	0.947	0.029	
Analysis of variance					
Source	SSQ	DF	MSQ	<i>F</i> -ratio	<i>p</i>
Regression	10.940	2	5.470	8.156	0.004
Residual	10.060	15	0.671		

Discussion and Conclusions

- Improvements achieved by periodontal surgery may be maintained stable up to 5 years.
- Subtraction parameters suitably describe bony fill after periodontal therapy as evidenced by the gold standard of PBL measurements.

Abbreviations

GI: Gingival Index
 PII: Plaque Index
 PD: probing depth
 CAL-V: vertical clinical attachment level
 CAL-H: horizontal clinical attachment level
 PBL-V: vertical probing bone level
 PBL-H: horizontal probing bone level
 SD: standard deviation
 SSQ: sum of squares
 MSQ: mean of squares
 DF: degrees of freedom

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Poster Faksimile:

Evidence for healing of intrabony and furcation defects after periodontal therapy: digital subtraction and bone measurements # 10

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Abstract
 The aim of the study was to evaluate the clinical and radiographic effects of a 6-month periodontal therapy (PT) on the healing of intrabony and furcation defects. The study was conducted in a randomized controlled trial. The patients were divided into two groups: a control group (n=10) and a PT group (n=10). The PT group received a 6-month PT. The clinical and radiographic parameters were measured at baseline, 3, 6, and 12 months. The results showed that the PT group had significantly better clinical and radiographic outcomes compared to the control group. The clinical parameters (GI, PII, PD, CAL-V, CAL-H, PBL-V, PBL-H) improved significantly in the PT group. The radiographic parameters (bone density, bone area) also improved significantly in the PT group. The results indicate that a 6-month PT is effective in healing intrabony and furcation defects.

Material and Methods II
Clinical Assessment
 All 8 patients in each baseline, 6, 12, 18 months after surgery:
 • Gingival Index (GI) and Plaque Index (PI)
 • PD and CAL-V to the nearest 0.5 mm (POPUNC 15)
 • CAL-H to the nearest 0.5 mm in class II furcations (PO20)
Periodontal surgery
 • Mucoperiosteal flap, the rough debridement alone in 8 defects and GTR in 24 defects using ePTFE (14 defects) and Polyacton 910 (10 defects) barriers.
 • Removal of ePTFE barrier after 4 to 6 weeks.
Bone measurement
 After resection of a full thickness flap and under local anesthesia 60-90 minutes after surgery:
 • Diapers cross-sectional function (DCS) to the most apical extension of the bony defect (SD)-PBL-V.
 • Horizontal probing bone level in class II furcations: PBL-H.
Image processing
 Measurements using a loupe of 10 fold magnification and a 0.1 mm grid (Scale Image 10, Peak, Tachik Sangyo, Tokyo, Japan):
 • Distance between the projected one of the orthodontic wire that had been fixed to the fibrotissue vertically (V) and horizontally (H) on every radiograph.
 • Clipping of each radiograph with a CCD camera: Coda Soft State Camera, Coda Inc., San Diego, CA.
 • All radiographs were analyzed by one examiner blinded to the clinical and (re)surgical measurements (E1).
Statistical analysis
 • Kolmogorov-Smirnov U-Test for normal distribution.
 • Comparison of baseline 0 and 60 months post-surgical measurements by paired t-test.
 • Spearman and t-test linear regression analysis: dependent variable: PBL-V, PBL-H; independent variable: PBL-VH, subtraction of parameters, GTR therapy, patient.
 • Simple regression analysis: relative density (PBL-V), net area change (PBL-H).

Results

Tab. 1: Clinical parameters (means SD)

	GI	PI	PD/mm	CAL-V/mm	CAL-H/mm
Baseline	1.9±0.4	0.9±1.0	5.9±1.5	6.4±1.9	4.8±0.8
6 months	0.7±1.0	0.5±0.8	3.2±0.8	4.6±1.5	3.0±1.0
Change	-1.2±1.0	-0.4±1.1	-2.7±1.0	1.8±1.2*	1.8±0.8*
60 months	0.8±1.0	0.7±0.9	4.0±1.4	5.2±1.8	3.0±1.3
Change	-0.9±1.2	-0.3±1.5	-1.9±1.6	1.2±1.9†	1.8±1.0*

Tab. 2: Bone parameters (means SD)

	PBL-V/mm	rel. density (area)	PBL-H/mm	net. area change
Baseline	6.4±1.8		4.5±0.8	
60 months	6.2±1.8		3.5±1.1	
Change	0.2±1.8	7.8±13.0	1.0±2.1*	0.7±1.3

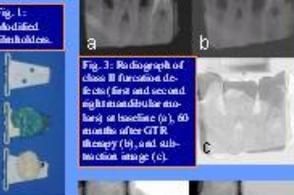


Objective
 Comparison of digital subtraction analysis to the gold standard of intrasurgical measurements 5 years after periodontal surgery of intrabony and furcation defects.

Conclusions
 • Improvements achieved by periodontal surgery may be maintained stable up to 5 years.
 • Subtraction of parameters suitably describe bony fill after periodontal therapy as evidenced by the gold standard of PBL measurements.

Tab. 3: Subtraction multiple linear regression analysis. Dep. variable: PBL-V gain/mm (60 months); n=30; R²=0.93; F_{total} = 0.91; s.e. (all data) = 0.58

	B	SE(B)	B	P
Constant	-1.340	0.761		0.091
Baseline PBL-V	0.942	0.094	0.940	0.002
Relative density loss	0.040	0.010	0.941	0.000
GTR therapy	0.068	0.341	0.852	0.097
Patient 1	-1.976	0.617	0.622	0.008
Patient 2	1.054	0.460	0.504	0.029
Patient 3	-6.151	0.493	0.989	0.000
Patient 12	-1.198	0.442	0.553	0.010
Patient 13	-1.213	0.444	0.524	0.014



Material and Methods I
Patients
 • 10 patients (8 female) 32-64 years of age.
 • Unresected advanced periodontal disease.
 • Each subject had at least one intrabony or furcation class II furcation defect.
Radiographic examination
 • Standard and bisecting radiographs of teeth with intrabony and furcation defects using modified film holders (SP-2 Film Positioning, Ultrad Corp., Park Lakeside, IL, USA) (Fig. 1, 2) at baseline, 6, and 60-3 months after surgery. Two orthodontic wires were placed on the mandibular side of the fibrotissue at a standard position (Fig. 3). Shortness of these wires were cast into the radiographs. From the distances between the images of these wires on a radiograph, the vertical and horizontal projection distances between the consecutive radiographs could be calculated.
 • Intraoral dental films (Ultraspeed, Ektamax Kodak Co., Rochester, NY, USA) size 2.
 • X-ray source (Hilalux 70, 70 kV, 7 mA, Siemens, Bensheim, Germany).
 • Development unit (Perimate, Dürr Dental GmbH, Bietigheim-Bissingen, Germany).

Conclusions
 • Improvements achieved by periodontal surgery may be maintained stable up to 5 years.
 • Subtraction of parameters suitably describe bony fill after periodontal therapy as evidenced by the gold standard of PBL measurements.

Tab. 4: Subtraction multiple linear regression analysis. Dep. variable: PBL-H gain/mm (60 months); n=18; R²=0.82; F_{total} = 0.75; s.e. (all data) = 0.62

	B	SE(B)	B	P
Constant	0.480	0.253		0.097
Net area change	0.408	0.197	0.947	0.020
Patient 8	1.262	0.332	0.947	0.029



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