

Intrasurgical and computer-assisted radiographic measurement of interproximal bone loss: A comparison of 2 methods

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Objective

Comparison of computer-assisted linear measurements of interproximal intrabony defects on radiographs using two different methods with the gold standard of intrasurgical measurements.

Material and Methods

Patients

- 22 patients (11 female) 34 -64 years of age.
- untreated advanced periodontal disease.
- each exhibiting at least one interproximal intrabony defect.

Radiographic examinations

- standardized bitewing radiographs of teeth with intrabony defects using modified film holders (VIP 2 Film Positioning, UpRad Corp., Fort Lauderdale, FL, USA) (Fig. 1, 2). 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 (Fig. 3). From the distances between the images of these wires on a radiograph, the vertical and horizontal angulation difference between the central beam and the orthoradial projection 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:
c: central beam;
o: orthoradial,
 $a = \arctan d/20$.

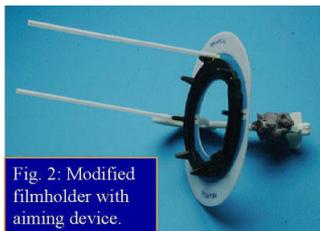
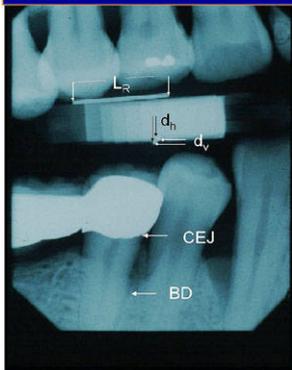


Fig. 2: Modified filmholder with aiming device.

Fig. 3: Radiograph of intrabony defect mesial a right second premolar: if the CEJ was destroyed by restorations the restoration margin was chosen as landmark.



Clinical examinations

At 6 sites per tooth:

- Gingival Index (GI) and Plaque Index (PII).
- PD and PAL-V to the nearest 0.5 mm (PCPUNC 15).

After reflection of a full thickness flap:

- distance cemento-enamel junction (CEJ) to the most apical extension of the bony defect (BD).
- the height of the 3-wall as well as the 2- and 3-wall component of each interproximal lesion.
- all clinical measurements were performed by one examiner (PE) to the nearest 0.5 mm (PCPUNC 15).

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 (Fig. 3).
- the length LR of the cast shadow of the wire placed on the maxillary side of the filmholder and calculation of the radiographic enlargement of each radiograph (Fig. 3).

side-by-side	LMSRT
• capturing of each radiograph with a CCD camera: Cohu Solid State Camera, Cohu Inc., San Diego, CA	WV-BD 400 Panasonic, Secaucus, NJ
• enlargement: 8x	4/10x
• all radiographs were analysed by 2 examiners blinded to the clinical and intrasurgical measurements: EH	TSK.
• adjustment of all radiographic measurements according to the enlargement of each individual radiograph.	

Definition of landmarks

BD was defined as most coronal point where the periodontal ligament space showed a continuous width. If no periodontal ligament space could be identified the point where the projection of the AC crossed the root surface was taken as landmark. If both structures could be identified at one defect, the point defined by the periodontal ligament was used as BD. If several bony contours could be identified the most apical that crossed the root was defined as the BD.

Statistical analysis

- Kolmogorov-Smirnov/Lilliefors-Test for normal distribution.
- comparison of intrasurgical/radiographic measurements by paired t test.
- stepwise multiple linear regression analysis:
 - dependent variable: Diff. intrasurgical/radiographic measurements
 - explanatory variables: patient, angulation differences, analysing method, intrasurgical parameters.

Results

Results	33 radiographs of 34 intrabony defects					
Tab.1:	clinical parameters			angulation/ ^o		
	GI	PIL	PD/mm	PAL-V/mm	vertical	horizont.
mean±SD	1.9±0.3	0.3±0.7	8.3±1.8	9.0±1.6	2.5±1.5	0.8±0.7
interval	1.0-2.0	0.0-3.0	5.5-12.0	6.5-13.0	0.0-5.5	0.0-2.6

Tab. 2:	intrasurgical		radiographic parameters/mm	
	mean±SD	interval	mean±SD	interval
CEJ-BD	9.2±2.1	5.0-14.0	LMSRT	8.4±1.9 $p < 0.05$
			side-by-side	7.7±2.1 $p < 0.005$
high				
2/3wall	4.4±1.6	0 - 8.5	difference	LMSRT-side-by-side
3wall	2.4±1.5	0 - 4.5		0.7±2.3 n.s. ($p = 0.084$)

Tab. 3: stepwise multiple linear regression analysis:					
dep. variable: Δ CEJ-BD intrasurgical - radiographic/mm;					
n = 68; R ² = 0.515; R ² _{adjusted} = 0.458; s.e.(estimate) = 1.532					
	b	s.e.(b)	β	p	
constant	-3.357	0.898		0.000	
patient 12	-2.288	0.802	0.970	0.006	
patient 13	-1.900	0.812	0.945	0.023	
2wall component	0.375	0.294	0.694	0.008	
CEJ-BD intrasurgical	0.472	0.098	0.856	0.000	
analysis of variance					
source	SSQ	DF	MSQ	F-ratio	p
regression	149.520	7	21.360	9.095	0.000
residual	140.913	60	2.349		

Discussion and Conclusions

- both computer-assisted analyses of linear distances on radiographs underestimated the amount of interproximal bone loss as assessed by intrasurgical measurements.

- it appears that there are no major differences between different computer-assisted analyses in underestimating interproximal alveolar bone loss.

Abbreviations

GI: Gingival Index
 PII: Plaque Index
 PD: probing depth
 PAL-V: vertical probing attachment level
 CEJ: cemento enamel junction
 AC: alveolar crest
 BD: bony defect
 SD: standard deviation
 SSQ: sum of squares
 MSQ: mean of squares
 DF: degrees of freedom

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Poster Faksimile:

Intrasurgical and computer-assisted radiographic measurement of interproximal bone loss: A comparison of 2 methods # 3496

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Abstract

Computer-assisted linear measurements of interproximal alveolar bone loss on radiographs using two different methods with the gold standard of intrasurgical measurements.

Objective

Comparison of computer-assisted linear measurements of interproximal alveolar bone loss on radiographs using two different methods with the gold standard of intrasurgical measurements.

Materials and Methods I

22 patients (11 female) 34-64 years of age, untreated advanced periodontal disease, each exhibiting at least one interproximal alveolar defect.

Radiographic examination

Standardized bitewing radiographs of teeth with interproximal defects using modified film holders (VSP 2 Film Positioning Lip-Rest Corp., Fort Lauderdale, FL, USA) (Fig. 1, 2). Two orthodontic wires were placed on the mandibular side of the filmholder at a specified position (Fig. 3). Shadowing of these wires were cast onto the radiographs (Fig. 3). From the distances between the images of these wires on a radiograph, the vertical and horizontal angulation difference between the central beam and the orthodontic projection could be calculated.

intraoral dental films (Ultrapad, Eastman Kodak Co., Rochester, NY, USA) size 2.

ray source (Hülndert 70, 70 kV, 7 mA, Siemens, Bensheim, Germany).

development unit (Perma-Dur Dental GmbH, Bietighalm-Biebingen, Germany).

Materials and Methods II

Clinical examination

All sites per tooth:

- gingival index (GI) and Plaque Index (PI)
- PD and PAL-V to the nearest 0.5 mm (PCPLINC 35).

After installation of a full thickness flap:

- distance cemento-enamel junction (CEJ) to the most apical extension of the bony defect (BD).
- the height of the 2- and 3-wall components of each interproximal lesion.

All clinical measurements were performed by one examiner (PE) to the nearest 0.5 mm (PCPLINC 35).

Radiographic examination

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

- distance between the projections of the orthodontic wires that had been fixed to the filmholder vertically (d_v) and horizontally (d_h) on every radiograph (Fig. 3).
- the length, l, of the shadow of the wire placed on the mesial side of the filmholder and calculation of the radiographic enlargement of each radiograph (Fig. 3).

side-by-side LMSRT

- capture of each radiograph with a CCD camera: Coby, Solid State Camera, W-50 480 Coby, Inc., San Diego, CA; Panasonic, Secaucus, NJ enlargement: 8x
- all radiographs were analyzed by 2 examiners blinded to the clinical and intra-surgical measurements: SH
- adjustment of all radiographic measurements according to the enlargement of each individual radiograph.

Statistical analysis

- Kolmogorov-Smirnov-U-Test for normal distribution.
- comparison of intra-surgical/radiographic measurements by paired t-test.
- stepwise multiple linear regression analysis: dependent variable: intra-surgical/radiographic measurements
- explanatory variables: patient, angulation difference, analyzing method, intra-surgical parameter

Results

35 radiographs of 34 interproximal defects

Tab. 1: clinical parameters	angulation*					
	GI	PI	PD (mm)	PAL-V/mm	vertical	horizontal
mean±SD	1.9±0.3	0.3±0.7	5.3±1.8	9.0±1.6	2.5±1.6	0.8±0.7
interval	1.0-2.0	0.0-3.0	4.5-12.0	6.8-13.0	0.0-4.5	0.0-2.8

Tab. 2: intra-surgical	radiographic		param	stat	interval
	mean±SD	interval	mean±SD	interval	
CEJ-BD	9.2±2.3	6.0-14.0	LMSRT	6.4±1.9	4.0-12.7
side-by-side	7.7±2.1	4.0-13.4			

Tab. 3: statistical multiple linear regression analysis	intra-surgical - radiographic change		
dep. variable: CEJ-BD	n = 63	R ² = 0.416, R ² = 0.410; a.a.(est. error) = 1.632	
constant	-3.351	0.924	0.023
patient 12	-3.288	0.802	0.070
patient 13	-1.300	0.812	0.345
2-wall component	0.312	0.204	0.004
CEJ-BD intra-surgical	0.472	0.008	0.889

analysis of variance					
source	SSQ	DF	MSQ	F-value	p
regression	14.833	1	14.833	9.165	0.003
residual	10.013	60	0.167		

Conclusions

- both computer-assisted analyses of linear distance on radiographs underestimated the extent of interproximal bone loss as assessed by intra-surgical measurements.
- it appears that there are no major differences between different computer-assisted analyses in underestimating interproximal alveolar bone loss.



Fig. 1: Modified filmholder: central beam, 2- or 3-wall defect, a -wires at 2/3.



Fig. 2: Modified filmholder with string device.



Fig. 3: Radiograph of interproximal defect with a right-sided periodontal CEJ destroyed by a wire to reduce the distortion resulting in a choice as to which side to use.

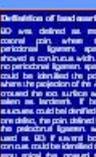


Fig. 4: Distribution of fixed wires. SD was defined as mesial control point, when the orthodontic ligament space showed a continuous width. If no periodontal ligament space could be identified the point, where the position of the AC crossed the area surface was taken as reference. If both surfaces could be identified as one defect, the point defined by the orthodontic ligament was used as SD. If several bony contours could be identified the mesial point located the furthest distance to the CEJ.

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