

Effects of proximal caries with loss of contact on alveolar bone levels in primary molars of Iraqi children using modified bitewing digital imaging

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Abstract

Destructive forms of periodontal disease can occur in children & adolescents. Proximal caries, gingival inflammation & loss of lamina dura are risk factors in development of alveolar bone loss. This study aims to determine the effect of proximal caries with loss of contact of primary molars on interdental hard tissues using a modified bitewing digital imaging technique. One hundred Iraqi children (7&8 years old) of both sexes were included in this study, half of them having proximal caries in their primary molars & served as study group & the other half served as control. The results showed a significant increase in marginal & interproximal alveolar bone crest height in study group with male predominance. Loss of lamina dura & irregular crestal bone appearance was also evident around primary molars with proximal caries. Non significant relationship was found between gingival inflammation & interdental hard tissues. The results indicated that proximal caries with loss of contact play an important role in development of incipient periodontal disease in children.

Keywords: proximal caries, crestal lamina dura, alveolar bone level, digital imaging

Introduction

Destructive periodontal disease in primary dentition is not uncommon & is characterized by rapid destruction of periodontal tissues, studies have been indicated that juvenile periodontitis in permanent dentition often proceeded by bone loss in primary dentition¹. Alveolar bone destruction remains the most important criteria for assessing the severity of periodontitis². This primarily diagnosed by radiographic evaluation of interdental bone level, bitewing radiographs are commonly taken for children for proximal caries detection but they also show the bone

heights around the first permanent molars, first & second primary molars, thus analysis of these radiographs provide good assessment of bone loss in children³. Different methods for the assessment of alveolar bone height have been commonly used in periodontal researches & practice, either with direct measurement with graded millimetric rulers or more elaborate method including the application of digital imaging & computer software programs⁴. Digital imaging techniques eliminate the use of silver halide emulsion X-ray films by capturing radiographic images on

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phosphor stimuable phosphate imaging plate (PSP) or charge couple device (CCD) which may improve & enhance the detection dental caries & alveolar bone loss⁵.

The aim of the present study is to determine the effect of proximal caries with loss of contact in primary molars on marginal & crestal bone appearance using modified bitewing digital imaging technique.

Materials and Method

The sample was consisted of 100 Iraqi healthy children (7&8) years old of both sexes, divided into 50 individual representing the study group (having proximal caries with loss of contact in one or more surfaces of primary molars) & 50 individual representing the control group (i.e. caries-free in proximal surfaces of primary molars) attending Pedodontic Dept. / College of Dentistry/ University of Baghdad. Digital images were considered acceptable for evaluation if they have no overlapping of interproximal contacts & a clear imaging of CEJ, marginal & crestal alveolar bone.

Two -sided proximal caries with loss of contact of the same tooth & exfoliating primary molars were excluded from the study⁶.

Each child was seated on a chair with stabilized head rest using a modified bitewing technique (the teeth in the upper & lower jaws are imaged separately using the same principles of ordinary bitewing , i.e., the occlusal plane is parallel to the floor, the central beam passes through interproximal contact point & is perpendicular to both object & sensor for the lower teeth & 5° positive angulations for the upper teeth with sensor- tube head edge distance fixed at 40 mm.) using 60 kVp , 8 mA & 0.032 sec. exposure

time for the lower teeth & .04 sec. for upper teeth.

Proximal caries assessment:

According to Mejare et.al.⁷ proximal caries was scored as follows:

Score 1: Radiolucency in the outer half of the enamel.

Score 2: Radiolucency in the inner half up to enamel-dentin border.

Score 3: Radiolucency with broken enamel-dentin border but with no obvious dentin involvement.

Score 4: Radiolucency with obvious spread in the outer half of dentin.

Score 5: Radiolucency in the inner half of dentin.

Score 1&2 were not seen in this study since teeth with loss of contact were the only teeth selected in the study group.

Marginal bone level assessment:

The distance between CEJ & marginal bone level was measured at the mesial & distal aspects of primary molars. If CEJ is difficult to determine (due to loss of contact) a line was drawn from CEJ of the intact surface of the same tooth & make it parallel with the cusp line (a line drawn from the tip of the mesial cusp to the tip of the distal cusp) the end of this line is to locate the missing CEJ. For the upper teeth (because of 5° positive angulations) the guideline for parallism is drawn from the midpoint between buccal & palatal cusps of the mesial site to the midpoint between buccal & palatal cusps of the distal site (fig.1).

Marginal bone loss occurred when the distance between the CEJ & marginal bone level > 2mm.¹ (fig.2).

Interproximal alveolar bone crests level assessment:

Interproximal alveolar bone crest height was measured by drawing a

reference line to connect the CEJ of first & second primary molars, then the point of the alveolar crest to the reference line was identified & a perpendicular line projected from that point is drawn to the reference line⁸ (fig.3).

The distance from the reference line of CEJ & alveolar bone crest was measured in each interdental area & scored as follows⁹:

- A: No bone loss (NBL): When the distance ≤ 2 mm.
 B: Questionable bone loss (QBL): When the distance > 2 mm. with partial loss of crestal lamina dura.
 C: Definite bone loss (DBL): When the distance > 2 mm. with complete loss of crestal lamina dura.

Crestal lamina dura assessment:

Crestal lamina dura was scored as:

- A: Present.
 B: Partial loss: when there is fuzziness & break in the continuity of lamina dura in the crestal area¹⁰.
 C: Complete loss^{9,11}.

Crestal bone appearance assessment:

Crestal bone appearance was scored as normal, irregular & sclerotic^{12,13}.

All measurements were performed on digital images using DIXI 2 configuration software which is installed from Dimaxis Pro Classic 3.2.1 software; high resolution mode was used with pixel size 19 μ m, sensor resolution of 26.3 lp/mm & image resolution of 26.3 lp/mm.

The following equation was used to obtain the measurement in mm.

$$\text{No. of pixels} \times \text{pixel size} = \text{Distance in mm.}$$

& inferential statistics & a comparison with a 5% level of significance was done.

To prevent bias in the results, inter & intra examiner calibration was performed on 20 randomly selected samples which showed a non-significant statistical difference.

Results

CEJ- Marginal bone level distance:

The mean values of CEJ-MBL were (2.43 \pm 0.78mm.) for study group & (1.36 \pm 0.48 mm.) for control group. A highly significant statistical difference was observed between the two groups (table 1).

The number of marginal bone loss in males was more than in females in study group & the number of marginal bone loss in the lower jaw sites was more than that of the upper jaw (table 2).

The mean CEJ-MBL distance was gradually increased with increase in proximal caries scores, but it does not reach a statistical significant level.

Interproximal alveolar bones crest height:

The mean values of the distance between reference line of CEJ-Alveolar bone crest of the study group was (1.73 \pm 0.71mm.) & was (1.08 \pm 0.31mm.) for control group, which showed a highly significant statistical difference (table3).

The number of crestal bone loss in males was more than females in both study & control groups without reaching a statistical significant level. The lower jaw demonstrated more crestal bone loss site than the upper jaw in the study group (table 4).

The mean of reference line CEJ-alveolar bone crest distance was gradually increased with increase in

proximal caries scores, ANOVA showed a significant relationship between them (table5).

Crestal lamina dura:

Table (6) showed the percentage of present, partial loss & complete loss of lamina dura in both study & control group. Chi square analysis reveals a highly significant difference.

Males have slightly more crestal lamina dura loss (partial & complete) than females in study & control groups (table7).

A significant relationship between the crestal lamina dura & the proximal caries scores ($p < 0.05$) as shown in table (8).

ANOVA showed a significant relationship between crestal lamina dura & the mean of both CEJ-MBL distance & reference line CEJ- Alveolar bone crest distance in study & control group ($p < 0.01$) as shown in table (9&10).

Crestal bone appearance:

Table (11) showed the number & percent of sites of normal & irregular crestal bone appearance of the study & control group.

Irregular crestal bone appearance was more in study group than in control group ($p < 0.001$) and males have more sites of irregular crestal bone appearance than females & the lower jaw sites have more irregular crestal bone appearance than the upper jaw sites (table 12 & 13).

Gingival & Plaque Index:

Statistical analysis showed a non significant relationship between gingival & plaque index with the mean of (CEJ-MBL) distance, & with the mean of the (reference line of CEJ-ABC) distance in the study & control groups. (table 14&15).

Discussion

Marginal bone loss occurred when the distance between the CEJ & marginal bone level $> 2\text{mm}$.¹ The mean CEJ-MBL distance was more in primary molars with proximal caries than that without caries ($2.43 \pm 0.78\text{mm}$.vs. $1.36 \pm 0.48\text{mm}$) this result is in agreement with the study of Sjoden & Mattson¹⁴ who measured the same distance on primary molars of children aged 7-9 years old. The reason for the increase in such distance in study group was due to loss of proximal contact that lead to food impaction which exerts a mechanical stress on the alveolar bone that lead to abnormal alveolar bone loss. In the present study mandibular primary molars of the study group have more marginal bone loss than maxillary one, this finding contradicts the finding of Sjoden & mattson¹ who found more bone loss in maxillary primary molars than in mandibular molars of Sweden children. This difference may be due to different methodology used & different ethnicity.

Bimstein⁹ used a score for measuring interproximal alveolar bone crest which is relied in this study. A highly significant increase in the mean of crestal bone height was evident in the study group when compared with the control group. This finding is in agreement with Bimstein & Jayne¹⁵ & Bimstein & Garcia¹⁶, suggesting that proximal decay appeared to have a deleterious effect on the alveolar bone. To prove that, Zhang et.al¹⁷ examined caries, restoration, food impaction, pulp pathosis, calculus & periodontal status in 106 Chinese children (3-10 years old) & found that alveolar bone loss present in 31 children (29%), most of the affected areas were located at the proximal surfaces of primary molars.

The number of sites with bone loss in males was more than in females in this study but without reaching a significant levels, this finding is in accordance with the finding of Bimstein & Garcia¹⁶ & Meragakis¹⁸. This sex difference could be due to neglecting oral hygienic methods in boys more than in girls.

Partial loss of crestal lamina dura in the study group was (58.2%) while in control group it was (0.0%), this loss may reflect loss of density & number of bone trabeculae which is a sign of incipient periodontal disease¹⁹. The reason was proved true in the present study which revealed a significant relationship between crestal lamina dura & alveolar bone loss, this finding come side by side to the finding of Bimstein & Garcia¹⁶. Rams et al.²⁰ found that radiographic lamina dura status appears valuable for assessing of incipient periodontal disease activity at interproximal tooth sites.

Irregularities of crestal bone appearance in the study group of this investigation was nearly twice more than that of control group (79.8% vs. 45.5%) , this irregularities may be attributed to the presence of proximal caries that lead to subclinical inflammatory condition due to food impaction leading to itching& erosion of the crestal bone. The absence of sclerotic crestal bone sites in the study group is in agreement with the study of Kallestal & Mattson¹³ suggesting that the alveolar bone have no enough time to deposit bone on defected sites since the causal agents (caries & food impaction) are still in proximal areas which hinder bone deposition. This is confirmed by the increase in the bone loss with the increase in caries score.

Gingival & plaque indices have no apparent effect on interdental alveolar hard tissue in the present study, which come in accordance with the study of Sjoden & Matsson¹ & Bimstein &

Garcia¹⁶ indicating that open contacts are the main cause for incipient periodontal diseases in children.

Proximal caries with loss of contact play an important role in alveolar bone loss in primary dentition which can be considered as an indirect cause for incipient periodontal disease in primary dentition which necessitates urgent restorative treatment for primary dentition.

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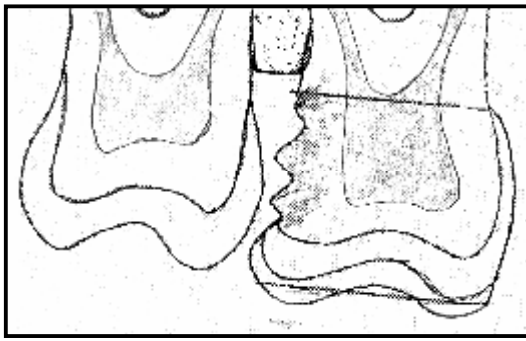
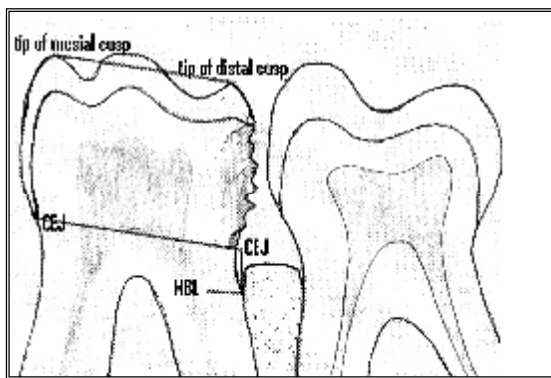


Figure (1): CEJ determination in decayed site of upper teeth.



Figure(2): CEJ-MBL distance determination in sites with loss of contact due to caries

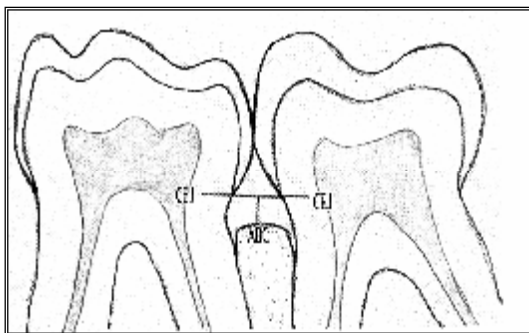


Figure (3): Measurement of the distance from the reference line of CEJ to Alveolar bone crest

Table (1) Mean of (CEJ-MBL) distance in millimeters of study and control group.

(CEJ-MBL) distance	Study group	Control groups
Mean	2.4352	1.3699
Std	0.7846	0.4885
T-test	15.22	
DF	339	
P-value	0.0001	

Table (2) Mean of (CEJ-MBL) distance millimeters of male & female and upper & lower jaw sites in study and control group.

(CEJ-MBL) distance	male		female		upper		lower	
	study	control	study	control	study	control	study	control
Mean	2.4022	1.3450	2.4786	1.3947	2.334	1.4077	1.7555	1.1078
STD	0.7440	0.4933	0.8419	0.4844	0.6197	0.4895	0.6645	0.3139
T	11.275		10.243		9.009		8.872	
DF	175		162		140		197	
P-value	0.0001		0.0001		0.0001		0.0001	

Table (3) Mean of (reference line of CEJ-ABC) distance millimeters of study and control group.

(reference line of CEJ-ABC) distance	Study group	Control groups
Mean	1.7319	1.0888
Std	0.714	0.3115
T-test	11.609	
DF	324	
P-value	0.0001	

Table (4) Mean of (reference line of CEJ-ABC) millimeters of male & female and upper & lower in study and control group.

(reference line of CEJ-ABC) distance	male		female		upper		lower	
	study	control	study	control	study	control	study	control
Mean	1.7555	1.1078	1.7151	1.0651	1.6800	1.0998	1.7666	1.0757
STD	0.6645	0.3139	0.7728	0.3133	0.551	0.3784	0.7766	0.2478
T	8.872		7.609		6.885		9.297	
DF	167		155		140		181	
P-value	0.0001		0.0001		0.0001		0.0001	

Table (5) Relationship between caries score and the mean of the distance (Reference line of CEJ-ABC) in millimeters.

Caries score	Mean(Reference line of CEJ-ABC) distance	STD	F	DF	p-value
3	1.3024	0.3993	2.235	2	0.01
4	1.7333	0.5978			
5	1.8867	0.8372			

Table (6) Number and percent of sites with present, partial loss and complete loss of crestal lamina dura in study and control group.

Crestal lamina dura	Study		Control	
	No	%	No	%
present	5	5.1	159	67.1
Partial loss	36	36.7	78	32.9
Complete loss	57	58.2	0	0
Total	98	100	237	100
X2	192.5			
DF	2			
p-value	0.0001			

Table (7) Number and percent of sites with present, partial loss and complete loss of crestal lamina dura in male & female in study and control group.

Crestal lamina dura	male				female			
	study		control		study		control	
	No	%	No	%	No	%	No	%
present	2	3.5	77	64.7	7	15.9	84	70
Partial loss	21	36.2	42	35.3	15	34.1	36	30
Complete loss	35	60.3	0	0.0	22	50	0	0.0
Total	58	100	119	100	44	100	120	100
X2	104.3				77.149			
DF	2				2			
p-value	0.0001				0.0001			

Table (8) Relationship between the proximal caries score & number , percent of sites with present, partial loss & complete loss of crestal lamina dura

Proximal caries scores	Crestal lamina dura					
	present		Partial loss		Complete loss	
	No	%	No	%	No	%
3	2	25	9	33.3	5	10.6
4	5	62	9	33.3	17	36.2
5	1	13	9	33.4	25	53.2
Total	8	100	27	100	47	100
X2	9.607					
DF	4					
p-value	0.047					

Table (9) The relationship between crestal lamina dura and the mean of the (CEJ-MBL) distance in millimeters in study and control groups.

Groups	Crestal lamina dura	Mean (CEJ-MBL) distance	std	F	DF	p-value
study	Present	1.7140	0.7376	7.824	2	0.001
	Partial loss	2.4769	0.7465			
	Complete loss	3.3200	0.3223			
control	Present	1.3053	0.4732	8.654	2	0.004
	Partial loss	1.4990	0.4959			
	Complete loss	0	0			

Table (10) The relationship between crestal lamina dura the mean of the distance between (reference line of CEJ-ABC) distance in millimeters in study and control groups.

Groups	Crestal lamina dura	Mean (reference line of CEJ-MBL) distance	std	F	DF	p-value
study	Present	1.360	0.261	7.808	2	0.001
	Partial loss	1.766	0.751			
	Complete loss	2.635	0.410			
control	Present	1.185	0.307	7.625	2	0.006
	Partial loss	1.006	0.323			
	Complete loss	0	0.261			

Table (11) Number and percent of surface of normal and irregular crestal bone appearance of study and control group.

Marginal appearance	Study		Control	
	No	%	No	%
normal	20	20.2	122	54.5
irregular	79	79.8	102	45.5
Total	99	100	224	100
X2	32.71			
DF	1			
p-value	0.0001			

Table (12) Number and percent of surface of normal and irregular crestal bone appearance of male and female in study and control group.

Crestal bone appearance	male				female			
	study		control		study		control	
	No	%	No	%	No	%	No	%
normal	11	19.6	66	60	9	20.9	46	40.3
irregular	45	80.4	44	40	34	79.1	68	59.7
Total	56	100	110	100	43	100	114	100
X2	24.302				5.174			
DF	1				1			
p-value	0.0001				0.0075			

Table(13)Number and percent of surfaces with normal and irregular marginal appearance of upper and lower sites in study and control group.

Crestal bone appearance	upper				lower			
	study		control		study		control	
	No	%	No	%	No	%	No	%
normal	11	32.4	24	27.9	19	27.9	98	71
irregular	23	67.6	62	72.1	49	72.1	40	29
Total	34	100	86	100	68	100	138	100
X2	0.949				32.710			
DF	1				1			
p-value	0.6221				0.0001			

Table (14) Relationship between Gingival index with Mean of (CEJ-MBL)& (reference line of CEJ-ABC) distance in millimeters in study and control group.

Groups	GI	Mean (CEJ-MBL) distance	std	t	DF	p-value
study	0-1	2.4075	0.8074	-0.262	100	0.79
	>1-2	2.4503	0.777			
control	0-1	1.1178	0.2018	-0.33	238	0.56
	>1-2	1.1136	0.2182			
	GI	Mean (reference line of CEJ-ABC) distance				
study	0-1	1.8739	0.7006	1.437	99	0.15
	>1-2	1.6632	0.7080			
control	0-1	1.0758	0.3349	-0.650	237	0.51
	>1-2	1.1027	0.2808			

Table (1^o) Relationship between plaque index with Mean of (CEJ-MBL) & (reference line of CEJ-ABC) distance in millimeters in study and control group.

Groups	PI	Mean (CEJ-MBL) distance	std	t	DF	p-value
study	0-1	2.3394	0.7102	-0.549	100	0.58
	>1-2	2.4544	0.8011			
control	0-1	1.3647	0.4917	-0.113	238	0.91
	>1-2	1.3724	0.4884			
	PI	Mean (reference line of CEJ-ABC) distance				
study	0-1	1.6071	0.5562	-0.836	99	0.40
	>1-2	1.7649	0.7362			
control	0-1	1.045	0.3430	-0.610	237	0.54
	>1-2	1.0781	0.2992			