



RADIOGRAPHIC ASSESSMENT OF ALVEOLAR BONE CREST LEVELS IN 9-12 YEAR OLD CHILDREN IN DAVANGERE, INDIA

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ABSTRACT

Background: Recent studies have indicated that aggressive periodontitis in the permanent dentition of adolescents often is preceded by bone loss in the primary and mixed dentition. Hence it is necessary to detect and treat these patients for preventing the transition of the disease from primary to permanent dentition. Aims and Objectives: The aim of this study was to radiographically determine the cemento-enamel junction (CEJ) to alveolar bone crest (ABC) distance in the interproximal areas of permanent molars and central incisors during the mixed dentition period. Materials and Methods: The study was a cross sectional study spanned over a period of one year. Panoramic radiographs were taken for 410 children residing in Davangere, Karnataka aged between 9-12 years. CEJ-ABC distance was measured at the mesial and distal surfaces of permanent first molars and permanent central incisors. Statistical analysis: Independent t-test was applied to compare CEJ-ABC distances measured in males and females, in the two age groups, the maxillary permanent central incisors and maxillary permanent first molars, the maxillary permanent first molars and mandibular permanent first molars. Results: The CEJ-ABC distance was less than 2mm in more than 95% of the sites. In some of the sites the distance when it was more than 2mm could be suggestive of normal physiology during mixed dentition period. Conclusion: The radiographic distance between CEJ-ABC if more than 2mm could be physiologic and hence requires to be deciphered by clinical evaluation.

Keywords: Cementoenamel junction, Aggressive periodontitis, Mixed dentition, Panoramic radiography.

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1. INTRODUCTION

Radiography is a powerful auxiliary tool for the diagnosis of periodontal diseases. Reed and Polson [1] suggested that bitewing and periapical techniques provided significantly different values in assessing crestal alveolar bone levels. According to Gedik, et al. [2], both bitewing and

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panoramic radiography are preferred to periapical images for crestal bone assesment. [Persson, et al. \[3\]](#) concluded that OPG radiographic readings may substitute for full-mouth periapical radiographic evaluation. Panoramic radiography produces single image of maxillary and mandibular arches ,requires less radiation and saves time [\[4\]](#).

According to [Mann, et al. \[5\]](#) ,the quantitative changes in the distance from the cementoenamel junction (CEJ) to the alveolar bone crest (ABC) is an important radiographic evidence of initial periodontal breakdown and should be greater than 2mm [\[6\]](#).

Recent studies have indicated that aggressive periodontitis in the permanent dentition of adolescents is often preceded by bone loss in the primary dentition. 40% of patients diagnosed as having juvenile periodontitis had experienced bone loss in primary teeth [\[7\]](#). [Sweeney, et al. \[8\]](#) found a prevalence of marginal bone loss of 0.8% in primary teeth of 5-11 year old children and) and another study reported a prevalence of 11.4 % in both primary and permanent teeth of 4-9 year old children [\[9\]](#). These results stress the importance of early recognition and treatment of these patients for the purpose of preventing the transition of the disease from the primary to the permanent dentition [\[6\]](#).

A medline search using keywords mixed dentition, aggressive periodontitis, panoramic radiography, cementoenamel junction and alveolar bone crest revealed no such study in the age group 9-12 years. Hence the purpose of the present study was to radiographically determine the cementoenamel junction (CEJ) to alveolar bone crest (ABC) distance in the interproximal areas of permanent molars and central incisors during the mixed dentition period for early detection of transition of aggressive periodontitis from primary to permanent dentition and also to assess the bone changes in prevalence of periodontitis in a population with mixed dentition.

2. MATERIALS AND METHODS

The study was reviewed and approved by the ethical committee of the College of Dental Sciences, Davangere and was in accordance with the Helsinki Declaration of 1975, as revised in 2000. A written consent was obtained from each patient who participated in the study. The patients for this cross sectional study were selected from the schools in and around Davangere, Karnataka, India.410 healthy 9-12 year old school going children with fully erupted permanent first molars and central incisors with no clinical evidence of dental caries, no diastema, no fillings in the intermolar areas, no history of previous orthodontic treatment, no systemic diseases were selected for the study. The children were divided into two age groups, Group 1 comprising of children in 9-10 years age range and Group 2 which comprised of children in 11-12 years age range. The panoramic radiographic films were exposed to an X-ray source (Gendex Orthoralix, Finland) using 70 kVp,10 mA for 11 seconds. The radiation exposure caused by panoramic radiography is approximately 0.010 mSv which is much negligible than that caused by CT scans. The radiographs were then examined according to the age of the child. The selected radiographs had minimal evidence of distortion, minimal evidence of overlapping, and a clear image of CEJ and alveolar bone crest in permanent first molars and central incisors. Radiographic analysis was

done for 11 surfaces which included the mesial and distal surfaces of permanent first molars and mesial and distal surfaces of permanent maxillary central incisors. The distance between the cemento-enamel junction and the alveolar bone crest was recorded as a bone loss when it was greater than 2mm [6]. The crest of the alveolar bone was defined as the most coronal level where the periodontal membrane retained its normal width [10]. Teeth were considered to be exfoliating if the root surfaces had advanced to the extent that the radiographic image of the periodontal ligament was not discernible. A permanent tooth was considered to be erupting if its cusp tips had not reached occlusion in the radiograph [11]. The selected radiographs were scanned and measurements were done using a software called Coreldraw X4 (2008 Corel Corporation) [figure 1,2,3]. Measurements were only performed on fully erupted teeth which were in function. All measurements were done by one calibrated examiner. These data were subjected to statistical analysis. The recorded measurements were classified based on Bimstein, et al. [12]: Group I – No Bone loss: the distance between CEJ-ABC is $\leq 2\text{mm}$; Group II – Questionable bone loss: the distance between CEJ-ABC is $>2\text{mm}$ and $< 3\text{mm}$; and group III – Definite bone loss: the distance between CEJ-ABC is $\geq 3\text{mm}$. Independent t-test was applied to compare CEJ-ABC distances measured in males and females, in the two age groups, the maxillary permanent central incisors and maxillary permanent first molars, the maxillary permanent first molars and mandibular permanent first molars.

3. RESULTS AND DISCUSSION

The distribution of the included subjects according to age and gender is shown in Table 1.

There were 410 panoramic radiographs which would yield 4510 surfaces for examination of which 55 surfaces were excluded and were considered as missing when they were not clear on the radiographs. The number of sites of maxillary anteriors (permanent central incisors) and maxillary and mandibular posteriors (permanent first molars) included in the investigation are shown in Table 2.

In 9-10 years group, the mean CEJ-ABC distance for all surfaces did not show significant difference in males ($1.54 \pm 0.38\text{ mm}$) and females (1.51 ± 0.40). Whereas in 11-12 years group, the mean CEJ-ABC distance of males ($1.57 \pm 0.52\text{ mm}$) showed significant difference than that of females of the same group ($1.53 \pm 0.46\text{ mm}$) [table 3]. In different age groups, the CEJ-ABC distance was significantly more in 11-12 year old males (1.57 ± 0.52) and females (1.53 ± 0.46) compared to 9-10 year old males ($1.54 \pm 0.38\text{ mm}$) and females (1.51 ± 0.40) respectively (table 4). The mean CEJ-ABC distance of maxillary anteriors (mesial and distal surfaces of permanent central incisor) in 9-10 years group ($1.35 \pm 0.37\text{ mm}$) was found to be less but not statistically significant than that of maxillary posteriors, i.e., mesial and distal surfaces of permanent first molar ($1.57 \pm 0.35\text{ mm}$); in 11-12 years group, the mean CEJ-ABC distance of maxillary anteriors ($1.34 \pm 0.37\text{ mm}$) was found to be significantly less than that of maxillary posteriors ($1.62 \pm 0.58\text{ mm}$) [table 5].

The mean CEJ-ABC distance in mandibular permanent first molars in 9-10 years group ($1.55\text{mm} \pm 0.35\text{ mm}$) was not significantly different than that of maxillary permanent 1st molars ($1.62 \pm 0.37\text{mm}$). In 11-12 years group, the mean CEJ-ABC distance in mandibular permanent first molars ($1.60 \pm 0.43\text{ mm}$) was significantly different than that of maxillary permanent 1st molars ($1.62 \pm 0.58\text{mm}$) [table 6].

When the sites whose CEJ-ABC distance was greater than 2mm were analysed, it was seen that almost 5% sites in males of 9-10 years group while 3.38% sites in females of the same group had a CEJ-ABC distance greater than 2mm. Similarly in 11-12 years group, almost 7% sites in males had a distance greater than 2mm, whereas in females, almost 3% sites showed a distance greater than 2mm. So in all, as shown in table 7, 206 surfaces out of the 4455 surfaces examined in both the age groups had a CEJ-ABC distance of greater than 2mm which was almost 4.62% of the total number of sites examined (table 7).

The age group 9-12 years was chosen because it generally marks the onset of puberty in males and females and the puberty-associated hormonal changes may change the microflora and/or the individual susceptibility of the subject towards early onset periodontitis [13]. Also localized early onset periodontitis primarily affects molars and incisors and tend to occur around puberty [14]. The children were further divided into group 1 (9-10 years) and group 2 (11-12 years). This was done as 9-10 years is actually the inter transitional period during mixed dentition period and is relatively stable while premolars and permanent 2nd molars erupt into the oral cavity during 11-12 years of age which could possibly alter the alveolar bone physiology during this time. The surfaces which were excluded either had substantial evidence of distortion or overlapping, or the image of CEJ and alveolar bone crest in permanent first molars and central incisors was not clear similar to exclusion criteria of [Ahmadi, et al. \[15\]](#).

Our study showed that the difference in CEJ-ABC distance between males and females in 9-10 years was not significant while it was greater in males than in females in 11-12 years age group. A study conducted by [Needleman, et al. \[16\]](#) on 223 children aged 7-9 years showed that males had significantly greater distances than females.¹⁶ However [Bimstein and Soskolne \[17\]](#), [Hart, et al. \[18\]](#) and [Loe and Brown \[19\]](#) and [Al Jamal, et al. \[20\]](#) in their respective studies conducted in age groups of 6-9 years showed contradictory results. Our study showed that the children (both males and females) in age group of 11-12 years have greater CEJ-ABC distance than in children of 9-10 years. In a longitudinal study conducted by [Shapira, et al. \[21\]](#) on 33 children, it was seen that the CEJ-ABC distance was stable at this period of age, while it increased between 4-6 and 9-12 years as a result of growth and development processes when the facial growth rate is maximal. [Bimstein and Soskolne \[17\]](#) found that CEJ-ABC distances increased linearly with age and this may be due to the wider age group (3-11 years) in their study. [Sjodin and Matsson \[22\]](#) could not demonstrate any association between age and CEJ-ABC distance in 7-9 years age group and they related this to the narrow age interval of the children in their study. [Al Jamal, et al. \[20\]](#) in his study showed that CEJ-ABC distance was not different among the four age groups (6,7,8,9 years) in a study conducted on 539 children.

The current study showed that the CEJ-ABC distance in maxillary permanent central incisors was almost similar to that of maxillary permanent first molars in 9-10 years age group while in 11-12 years age group it was less than that of maxillary permanent first molars. This can be attributed to the fact that the maxillary second premolars start erupting around 10-12 years of age and maxillary permanent 2nd molars start erupting during 11-13 years of age and there is some amount of physiologic bone loss around the permanent first molar during that time for this reason. This also possibly explains the reason for the gradual increase in CEJ-ABC distance with age in the permanent maxillary first molars. Whereas the maxillary permanent central and lateral incisors already erupt into the oral cavity by 8- 9 years of age. Hence the marginal bone around the maxillary anteriors is pretty stable during 9-12 year age.

The current study showed that the mean CEJ-ABC distance in the maxillary and mandibular permanent 1st molars were similar in the 9-10 year age group while it was significantly higher in maxillary permanent 1st molar than in mandibular permanent 1st molar in 11-12 year age group. According to Al Jamal, et al. [20] when comparing CEJ-ABC distances measured in the maxilla and mandible, it was found that teeth in the upper jaw had a statistically significant greater CEJ-ABC distance than in the lower jaw (0.90 ± 0.51 mm vs 0.77 ± 0.55 mm, respectively; $P < 0.001$). Similar results were shown by Shapira, et al. [21], Needleman, et al. [16], Dummer and Jenkis [23], Bishop, et al. [24] and Sjödin, et al. [7]. One possible reason for this could be that the cortical bone in maxilla is thinner, less dense and more rigid than that in mandible; therefore, the maxillary alveolar bone undergoes resorption more readily than that of the mandible when the permanent premolars and molars erupt into the oral cavity. However In another study by Sweeney, et al. [8] conducted on 2264 school going children, surfaces with bone loss were evenly distributed between the mandible and the maxilla. Also it was observed that the CEJ-ABC distance in maxillary and mandibular permanent first molar region increases with age progressing from 9-12 years. This can again be attributed to the fact that the permanent premolars and second molars start erupting into the oral cavity during this time resulting in physiologic bone loss around the permanent first molars.

Our study showed a total of 4.62 % of the sites had CEJ-ABC distances greater than 2mm. Bimstein, et al. [9] reported a prevalence of 11.4 % in both primary and permanent teeth of 4-9 year olds. Sweeney, et al. [8] found a prevalence of marginal bone loss of 0.8% in primary teeth of 5-11 year old children. Another study conducted by Ahmadi et al on primary molars showed 7.7% of the total examined surfaces had distances of greater than 2mm indicating the prevalence of alveolar bone loss. Needleman, et al. [16] have reported the prevalence of bone loss ranges from 0% to 51.5%. Sjödin and Matsson [6] reported a prevalence of marginal bone loss range of 0.2-4.5% in young school children in Sweden. Most of the epidemiological studies have shown that the prevalence of bone loss in the primary dentition varies between 0.27% and 28% [25].

4. CONCLUSION

- Males have a greater CEJ-ABC distance than that of females in 11-12 year age group.

- The CEJ-ABC distance in the 10-11 year age group is greater than that of the 9-10 year age group in both males and females
- The mean CEJ-ABC distance of permanent maxillary central incisors was less than that of maxillary permanent first molars in 11-12 year age group.
- The maxillary permanent first molars have a greater CEJ- ABC distance than that of the mandibular permanent first molars in the 11-12 year age group.
- The current study showed a total of 4.62 % of the sites had CEJ-ABC distances greater than 2mm.
- The sites in which the CEJ-ABC distance was more than 2mm could be suggestive of normal physiology of bone change during mixed dentition period. The radiographic measurements of CEJ-ABC distance requires to be deciphered along with clinical presentation of periodontal status, i.e., in terms of periodontal pocket to confirm whether greater than 2 mm distance is physiologic or pathologic.
- Further research is necessary in an evidence based approach to explore the threshold distances at sound surfaces to avoid overestimating pathological bone loss; and to isolate the effect of partial eruption/exfoliation on the CEJ-ABC distance.

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TABLES

Table-1. Age and genderwise distribution of the subjects

	9-10 years	11-12 years	Total
MALES	105 (25.6 %)	104 (25.36 %)	209 (50.97%)
FEMALES	112 (27.56 %)	89 (21.7 %)	201 (49.03%)
Total	217 (52.92 %)	193 (47.08%)	410

Table-2. Total no of surfaces examined and excluded in the study

	Total no of surfaces		Surfaces included		Surfaces excluded	
	anterior	posterior	anterior	posterior	anterior	posterior
Maxilla	1230	1640	1211	1620	19	20
Mandibular posteriors	1640		1624		16	

Table-3. Comparison of CEJ-ABC distance between males and females in 9-10 years and 11-12 years age group

	Group 1 (9-10 years)		Group 2 (11-12 years)	
	No of sites	CEJ-ABC Mean (mm)	No of sites	CEJ-ABC Mean (mm)
MALES	1133	1.54 ± 0.38	1144	1.57 ± 0.52
EMALES	1210	1.51 ± 0.40	968	1.53 ± 0.46
p value	>0.05 (not significant)		<0.05 (significant)	

* independent t test

Table-4. Comparison of CEJ-ABC distance between 9-10 years and 11-12 years age group in males and females

	MALES		FEMALES	
	No of sites	CEJ-ABC Mean (mm)	No of sites	CEJ-ABC Mean (mm)
Group 1 (9-10 years)	1133	1.54 ± 0.38	1210	1.51 ± 0.40
Group 2 (11-12 years)	1144	1.57 ± 0.52	968	1.53 ± 0.46
p value	<0.05 (significant)		<0.05 (significant)	

* independent t test

Table-5. Comparison of CEJ-ABC distance betweenmaxillary anteriors and maxillary posteriors in 9-10 years and 11-12 years age group

	Group 1 (9-10 years)		Group 2 (11-12 years)		P value
	No of sites	CEJ-ABC Mean (mm)	No of sites	CEJ-ABC Mean (mm)	
MAXILLARY ANTERIORS	639	1.35 ± 0.37	572	1.34 ± 0.37	>0.05 (not significant)
MAXILLARY POSTERIORS	857	1.57 ± 0.35	763	1.62 ± 0.58	<0.05 (significant)
p value	>0.05 (not significant)		<0.05 (significant)		

* independent t test

Table-6. Comparison of CEJ-ABC distance between maxillary and mandibular Permanent first molars in 9-10 years and 11-12 years group

	Group 1 (9-10 years)		Group 2 (11-12 years)		p value
	No of sites	CEJ-ABC Mean (mm)	No of sites	CEJ-ABC Mean (mm)	
MAXILLARY Permanent 1 st molars	857	1.62 ± 0.37	763	1.62 ± 0.58	<0.05 (significant)
MANDIBLULAR permanent 1 st molars	853	1.55 ± 0.35	771	1.6 ± 0.43	<0.05 (significant)
p value	>0.05 (not significant)		<0.05 (significant)		

* independent t test

Table-7. Percentage of sites showing CEJ-ABC distance >2MM in group 1 and group

	Group 1 (9-10 years)			Group 2 (11-12 years)		
	Total no of surfaces	No of surfaces >2 MM	Percentage	Total no of surfaces	No of surfaces >2 MM	Percentage
Males	1133	56	4.94	1144	81	7.08
Females	1210	41	3.38	968	28	2.89
Total	Total no of surfaces		No of surfaces >2 MM	Percentage		
	4455			4.62		



Figure-1. Identification of CEJ (Point A) and ABC (Point B) with the help of panoramic radiography



Figure-2. Measurement of distance between point A and point B

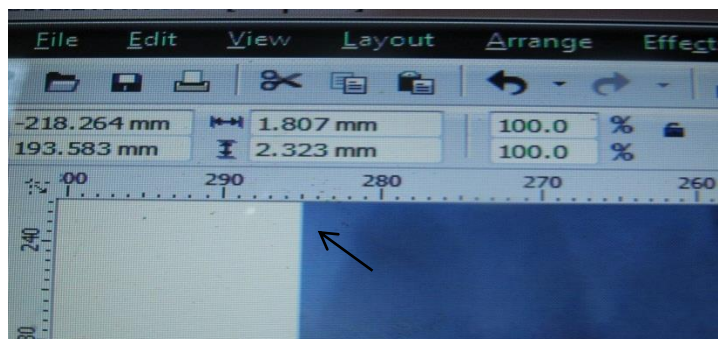


Figure-3. Measurement value between point A and point B displayed in the box pointed by the arrow

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