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Effect of root resorption of primary teeth on the development of its permanent successors: An evaluation of panoramic radiographs in 7–8 year-old boys

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Abstract. Root resorption in primary teeth can occur as a physiologic or pathologic phenomenon. Physiological root resorption occurs in healthy primary teeth or primary teeth with caries but no pulp involvement, whereas pathological root resorption occurs in primary teeth with pulpal caries. Knowledge about the effects of both physiological and pathological root resorptions in primary teeth on the development of its permanent successors is important for the development of an appropriate proper treatment plan. This study aimed to evaluate the effect of root resorption of primary teeth on the development of its permanent successors in boys aged 7–8 years. This descriptive cross-sectional study comprised 71 primary mandibular molars and premolars, which were screened using 32 sheets panoramic radiographs obtained from 7–8-year-old boys. Root resorption of primary teeth appeared to have no significant effects on the development of its permanent successors in the current study.

1. Introduction

Root resorption is a physiological process that occurs in primary teeth and is characterized by the activity of clastic cells resulting in loss of cementum and dentin in the root area [1]. This process is regulated by the dental follicle and stellate reticulum of permanent teeth, which affect the overlying healthy or caries-affected (but no pulp involvement) primary teeth [2]. Primary root resorption can also occur in the presence of pathological processes such as inflammation or necrosis in the pulp tissue [3]. Caries with pulp involvement is thought to be one of the causes of pathological primary root resorption [4]. Caries is included in the list of 10 primary diseases that affect children aged 5–9 years, with the prevalence of 21.6% [5-6]. It is more progressive in primary teeth because of the thin enamel and dentin structure, which enables the infection to spread quickly and affect the pulp tissue, leading to pathological root resorption [4,7].

Previous studies have shown that pathological primary root resorption is related to gender, age, and dental caries with pulp involvement. The prevalence of pathological primary root resorption based on gender was 16.2% and was higher in men than in women. The prevalence of pathological primary root resorption according to age was 19.4% in 3–7-year-old children and 13.7% in 8–12-year-old children. Caries with pulp involvement presented with the largest risk of pathological primary root resorption [4]. Moorrees technique, Fanning and Hunt technique, and measurements of the anatomical root length



using a radiograph are some of the methods used to determine the rate of root resorption in primary teeth [8,9].

The growth of permanent teeth consists of several stages and is affected by various factors, such as race, genetics, hormonal condition, nutrition, and the presence of caries (with pulp involvement) [10]. Various techniques such as those proposed by Moorrees, Anderson, Schour and Massler, Nolla, Garn, and Demirjian can be used to determine the stage of growth of permanent teeth [11].

One of the diagnostic tools used in mixed dentition is the panoramic radiograph, which demonstrates the relationship between the teeth and the supporting tissues and bone [12,13]. It is easy to use, has minimum radiation, and can be used in patients with limited mouth opening. In the present study, we aimed to analyze the effect of primary root resorption on the development of its permanent successor. The Demirjian technique was used to assess the growth of permanent teeth, whereas root resorption rate was assessed using the split technique, which divided the anatomic root length into three portions, apical one-third, middle one-third, and cervical one-third [9].

2. Methods

This was a descriptive cross-sectional study performed using panoramic radiographs of 7–8-year-old boys from Teaching Dental Hospital, Faculty of Dentistry, Universitas Indonesia in 2010–2012. The study sample comprised primary mandibular first and second molars and the tooth germs of the first and second premolars; the purposive sampling technique was used.

Inclusion criterion for the patients was the presence of good quality panoramic radiographs of boys aged 7–8 years. The panoramic radiograph was reproduced using a digital camera and viewer. The apical ends of the primary mandibular first and second molars and the tooth germs of mandibular first and second premolars were marked with a red dot on the digital version of the panoramic radiograph using the Adobe Photoshop CS3 program. The degrees of root resorption in the primary mandibular first and second molars were determined by measuring the length of the roots closest to the cervical area. The Demirjian technique was used to measure the growth of the germs of the mandibular first and second premolars.

Data analysis was performed using SPSS Statistics 20.0. Chi-Square test was used to ascertain significant differences between independent and dependent variables in the ordinal scale. The confidence level was set at 95% and significance at $p \leq 0.05$.

3. Results

The data distribution and frequency of panoramic radiographs based on age are presented in Table 1.

Table 1. Frequency distribution of panoramic radiograph data based on the age of the boys.

Age	N	%
7	17	53.13
8	15	46.87
Total	32	100

N, number of panoramic radiographs

Differences in pathological and physiological root resorption between the primary mandibular first and second molar are presented in Table 2.

No significant differences in pathological and physiological root resorption were observed between the primary mandibular first and second molars.

Table 3 illustrates the differences in the growth of the mandibular first and second premolars based on Demirjian's classification stages D and E.

Table 2. Differences in pathological and physiological root resorption between the primary mandibular first and second molars using the Chi-Square test.

Mandibular primary molars	Root resorption		N	%	P
	Physiological	Pathological			
Dm1	17	17	34	47.88	0.732
Dm2	20	17	37	52.12	
Total	34	37	71	100	

Dm1, Mandibular deciduous first molar; Dm2, Mandibular deciduous second molar

Table 3. Growth of mandibular first and second premolars based on Demirjian's classification stages D and E.

Premolar teeth	Stage		N	%	P
	D	E			
P1	14	20	34	47.88	0.013
P2	29	8	37	52.12	
Total	43	28	71	100	

P1, mandibular first premolar; P2, mandibular second premolar.

Significant differences in the growth of mandibular first and second premolars based on the classification stages were noted ($p < 0.05$). Therefore, the mandibular first and second premolars were differentiated in the subsequent calculations.

The effect of age on the growth of the mandibular first and second premolars during Demirjian's classification stages D and E are presented in Table 4.

Table 4. Effect of age on the growth of the mandibular first and second premolars during Demirjian's classification stages D and E.

Mandibular Premolar	Age	Stage				P
		D	E	N	%	
P1	7 Years	10	11	21	61.76	0.276
	8 Years	3	10	13	38.24	
P2	7 Years	17	2	19	56.34	0.232
	8 Years	13	5	18	43.66	

P1: First premolar; P2: Second premolar; $p < 0.05$ (significant difference)

Chi-Square tests revealed no significant differences in the growth of the mandibular first and second premolars between classification stages D and E.

Association between the resorption levels of primary mandibular molars and the growth of the first and second premolars during Demirjian's classification stages D and E are presented in Table 5.

Chi-Square test revealed no significant associations between the resorption levels of the primary mandibular molars and the growth of the mandibular first and second premolars according to Demirjian's classification stages D and E. Thus, pathological and physiological resorption of the primary roots appeared to have no significant effect on the growth of mandibular first and second premolars during Demirjian's stages D and E.

Table 5. Association between resorption levels of the primary mandibular molars and the growth of the mandibular first and second premolar during Demirjian's classification stages D and E.

Root resorption	P1				P
	D	E	N	%	
Cervical one-third	5	4	9	26.76	0.144
Middle one-third	7	9	16	40.84	
Apical one-third	1	8	9	32.4	
	P2				P
	D	E	N	%	
Cervical one-third	6	4	10	26.76	0.158
Middle one-third	12	1	13	40.84	
Apical one-third	12	2	14	32.4	

P<0.05 (significant difference)

Tables 6 illustrates the effects of pathological and physiological root resorption of primary mandibular molars, respectively, on the growth of the first and second premolars during Demirjian's classification stages D and E.

Table 6. The effect of pathological and physiological root resorption of primary mandibular molars on growth of the mandibular first and second premolars during Demirjian's classification stages D and E.

Root Resorption	Stage				P
	D	E	N	%	
Physiological	5	13	18	52.11	0.183
Pathological	8	8	16	47.89	
	P2				P
	D	E	N	%	
Physiological	15	4	19	52.11	1.00
Pathological	15	3	18	47.89	

P<0.05 (significant difference)

No significant differences in the effects of pathological and physiological root resorption of the primary mandibular molars were observed on the growth of the mandibular first and second premolars during the stages D and E.

4. Discussion

The age group (7–8 years) was selected in the present study because this is the age when the teeth enter the late primary dentition stage, where the primary incisive teeth are exfoliated, and the permanent teeth start to erupt [14]. This is also the age group with the highest caries prevalence (21.6%) [2]. Owing to the differences in the speed of growth of teeth between boys and girls, we chose to include only boys in the current study [15].

Primary mandibular molars were used in this study because they are known to present with the highest incidence of caries when compared with any other primary tooth [16]. Primary mandibular molars were categorized into two groups; sound teeth and carious teeth without pulp involvement were grouped together, whereas carious teeth with pulp involvement formed a separate group. The reason of this was that both sound and carious teeth without pulp involvement demonstrate physiological root resorption, whereas carious teeth with pulp involvement present with pathological root resorption [4].

Furthermore, mandibular molars were used because of the clarity and ease with which the stages of growth and level of resorption can be interpreted on the panoramic radiograph.

Root resorption levels of primary mandibular molar teeth were measured according to the length of the anatomical root and divided into three portions, cervical one-third, middle one-third, and apical one-third; this is a common method used for interpreting radiographs [3,9,17].

The subjects with age of 7–8 years were brought into consideration in the selection of choosing the teeth in assessing the growth. Teeth that had completed the stages of growth were not selected; instead, those which were about to complete their growth after the age of 7–8 years (mandibular first and second premolars) were chosen in the present study. Mandibular first and second premolars are the successors of the primary mandibular first and second molars. The formation of the hard tissues of the mandibular first and second premolars begins at 1.5–2 years and 2–3 years of age, respectively; the teeth erupt at the age of 10–11.5 years, and root formation is completed by 12–13 years of age [3]. Thus, variations in the growth of mandibular premolars and its relationship with carious primary mandibular molars, with or without pulp involvement, are to be expected at the age of 7–8 years.

The growth of permanent teeth can be assessed by several classifications; however, in the present study, the growth phase of permanent teeth was assessed according to the classification proposed by Demirjian because it evaluates growth based on the maturation process and not just the absolute length of the permanent teeth. This classification consists of eight stages of growth (A to H) using panoramic radiographs. Maturity of teeth begins from the formation stage to calcification, until the closure of the root apices. This method can be used in children aged 2–20 years [18,19].

No significant differences in resorption were observed between the primary mandibular first and second molars, which demonstrated pathological and physiological resorption, respectively (Table 2). This is contrary to the results of previous studies, which reported that pathological resorption occurs faster than physiological resorption as a result of damage to bones around the roots [3,20]. On the next calculation, primary mandibular first and second molar was not differentiated. In Table 3, a significant difference in growth was noted between the mandibular first and second premolars during Demirjian's classification stages D and E, so that the next calculation will differentiate mandibular first and second premolar. The growth of mandibular first premolars is faster than that of the second premolars, which may account for the significant difference between the two teeth [21].

As shown in Tables 4 and 5, age appeared to have no effect on the growth of the mandibular first and second premolars during Demirjian's classification stage D and E, indicating the presence of various stages in the growth of the tooth germ of the mandibular premolars at the age of 7–8 years. The study by Liversidge et al. reported no significant differences in the growth of permanent teeth based on chronological age; nevertheless, several stages of growth of the tooth germ were observed at the same age [22].

As shown in Tables 6 and 7, differences in the resorption levels of the primary mandibular molars did not affect the growth of the mandibular first and second premolars during Demirjian's classification stages D and E. These results indicate that the growth of the permanent teeth was not significantly influenced by the resorption of the cervical one-third, middle one-third, and apical one-third of the roots of the primary molars. This finding is supported by another study, which stated that the rate of root resorption of the primary teeth affects the eruption rate, but not the growth of the permanent teeth [4]. Similarly, in another study, the difference between the root resorption level of primary teeth toward the root formation of permanent teeth, which turned not significantly different [20].

Pathological and physiological root resorption of the primary mandibular molars appeared to have no effect on the growth of the mandibular first and second premolars (Tables 8 and 9). Based on previous research, carious primary teeth with pulp involvement can affect the germs of permanent teeth causing defects in the enamel. Inflammation as a result of caries with pulp involvement in the primary teeth during the *cap* or *bell* stages of the permanent teeth can lead to serious changes in the coronal and radicular morphology of the teeth. Enamel hypoplasia can occur if the inflammation progresses to the stage of enamel apposition. However, if the inflammation from caries with pulp

involvement in the primary teeth occurs during the calcification stage of the permanent teeth, changes in the microstructure of the enamel leading to changes in enamel opacity may occur, but the morphology of the tooth will not be altered. This happens when the crown of the permanent teeth has not been formed. Alternatively, no significant changes in the tooth germ occur if the crown of the permanent tooth is formed. Demirjian's classification stages D and E represent the stages where the crown of the permanent teeth is completely formed due to which the growth of the permanent teeth is not affected [23].

Eruption rate can also change due to caries with pulp involvement. Root resorption that occurs as a result of caries with pulp involvement causes damage to the bones, which quickens the rate of resorption [3,10]. Acceleration of eruption occurs if there is extensive alveolar bone damage due to chronic inflammation originating from the primary teeth. Delayed eruption can occur due to the formation of fibrosis tissue that forms a mechanical barrier against the eruption of permanent teeth. Eruption of permanent teeth occurs during Demirjian's classification stages F and G; therefore, no effect was noted during stages D and E [23].

5. Conclusion

The present study shows that the type or level of root resorption in primary teeth appears to have no effect on the growth of the permanent teeth.

6. References

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