THE RELATION BETWEEN THIRD MOLAR AGENESIS AND CRANIOFACIAL MORPHOLOGY

Nagwa M. Enany[1] Ahmed R. El-Kalza[2] Fatma O. El-Shikhy[3]

ABSTRACT

This study was done to determine the existence of any relation between bilateral agenesis of maxillary or mandibular third molar with antero-posterior dimension of maxilla, mandible and skeletal pattern. 82 initial records of Egyptian patients with bilateral congenitally missing third molars, either in maxilla / mandible were selected. The records were divided into four groups 1- bilateral missing of upper third molars, 2-bilateral missing of lower third molars, 3- bilateral missing of upper and lower third molars, 4- control group without missing. Molars Orthopantomographs were used to determine the presence or absence of third molars. Lateral cephalometeric radiographs used to carry out a cephalometric analysis including linear, angular and proportional measurements. After collecting the data, it was analyzed by means of Anova and Tukey tests.

The results obtained that mandibular plane angle were reduced, but not statistically significant. Whereas values of gonial angle in group III were significantly lesser than the control group (P =.006). For group III facial height was significantly less than the control group (P=.030).

The conclusion suggests that agenesis of upper and lower third molars related to a reduced gonial angle, and decreased facial height. The study showed a relation between third molars agenesis and facial morphology.

1- Professor of Orthodontics, Faculty of Dentistry, Alexandria University.
2- Lecture of Orthodontics, Faculty of Dentistry, Alexandria University.
3- Master student, Orthodontics Department, Faculty of Dentistry, Alexandria University

INTRODUCTION

Dental agenesis can be defined as any situation in which one or more teeth are missing because they have never been formed.[1] This can also be called oligodontia, dental aplasia, and congenital absence of teeth or hypodontia.[1] The term hypodontia refers to congenital lack of one or few teeth, while oligodontia refers to congenital lack of six or more teeth, and anadontia refers to complete lack of teeth which is very rare.[2] Hypodontia may be present as an independent anomaly or associated with a craniofacial syndrome.[3]

Surveys of permanent dentitions around the world during the 20th century have reported that prevalence of tooth agenesis between 2% to 10%.[4] Prevalence of hypodontia in different populations throughout the world varies considerably and has been reported to be 3.5-8%.[5] A meta-analysis of the prevalence of agenesis of permanent teeth suggested that agenesis differed according to geographic location and gender and was higher in Europe and Australia. In general, the prevalence of agenesis has been reported to be 1.4 times higher in females than males.[6]

Third molar is a tooth characterized by variability in time of its formation, widely varying crown and root morphology, and by its varying presence or absence in the oral cavity.[7]

Agenesis of this tooth is frequent, radiographic studies locate its prevalence between 7% - 26%.[8] The prevalence of third molar agenesis might be as high as 51.1%.[9]

Third molar agenesis influences the chronology of tooth eruption and number of teeth present in the dental arch. It also influences dentofacial structure.[10] Few studies have evaluated the relation between different kinds of agenesis and craniofacial structure, and those that do show conflicting results.[11-14]

Barrachina and Bravo,[11] in a sample of patients with agenesis of one or more teeth, suggest that, although the influence of hypodontia on craniofacial morphology is limited, agenesis affects the maxilla more than mandible.

Some authors have shown a relation between agenesis of different teeth and retrognathic maxilla.[8] Others, however, conclude that dental agenesis exerts little influence on dentofacial structures.[12]

In spite of the fact that third molar absence is the most frequent agenesis, only few studies has been carried out to evaluate the relation of this agenesis with maxillary anteroposterior dimensions and mandibular growth.[13]

Bishara suggested that there is no evidence that third molar is needed for the development of the basal skeletal components of the maxilla and mandible.[14] This compromise agrees with Ades and colleague,[15] who observed that persons with third molars that erupted into satisfactory function do not have a different mandibular growth pattern than those with third molars that are impacted or congenitally missing.

However, Kajii and colleagues[13] found that agenesis of third molar germs does not depend on anteroposterior dimensions of the mandible but depends on anteroposterior dimensions of the maxilla.

So, due to this conflicting results between the different studies, the purpose of this study is to determine the existence of any relation between bilateral agenesis of the upper and/or lower third molars with anteroposterior dimensions of the maxilla, mandible and with skeletal pattern.

MATERIALS AND METHODS

82 records of Egyptian patients seeking orthodontic treatment selected from Orthodontic Department at Alexandria University. The subjects were between 15-20 years with a mean age of 17.1 years. With no congenital deformities or syndromes, no extracted teeth or previous history of orthodontic treatment. Orthopantomograph of each patient was used to determine the presence or absence of third molars. The sample consisted of 82 records, 65 females and 17 males. The number of the

males was not sufficient enough to subdivided the groups according to gender, thus the records were divided into four groups according to the location of agenesis:[1]

- **Group 1:** (n = 22) subjects with bilateral agenesis of maxillary third molars.
- **Group 2:** (n =20) subjects with bilateral agenesis of mandibular third molars.
- **Group 3:** (n =20) subjects with bilateral agenesis of maxillary and mandibular third molars.
- **Group 4:** (n =20) subjects without third molars agenesis, with acceptable facial profile. Depends on lateral cephalometric radiographs.

Pretreatment cephalographs were used to carry out cephalometric analysis. The lateral cephalograph for each case was standardized. Every X-ray magnified by 1:1 and the scan was 100%. The X-ray unit used 68-70 Kvp, and 6 mA, with exposure time of 0.80 second. The lateral cephalograms when selected should show that the Frankfort horizontal parallel to floor, teeth in centric occlusion and lips at rest position. The cephalograms were traced manually. The tracing were repeated after one week by same investigator for more reliability. Each cephalogram was traced and measured twice. Tolerance limits of 1mm and 1° were set for difference between first and second observations of linear and angular measurements. If the limits were exceeded, a new tracing and measurements made. The most extreme was excluded. The average value of the two remaining observations was used. Linear,[13] angular and proportional[1] measurements were made.

The linear measurements were as following[1] (Figure 1):

- Distance A: distance between anterior and posterior nasal spine.
- Distance B: length of the maxillary basal bone.
- Distance C: length of the mandibular corpus.

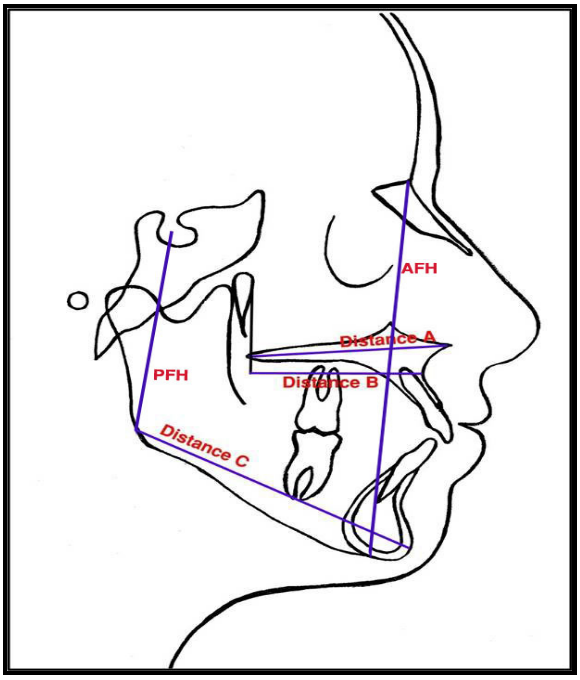

Figure 1: Linear and proportional measurements. Distance A: ANS - PNS, Distance B: Ptm - A point, Distance C: Go-Pog. Posterior facial height (PFH), anterior facial height (AFH).

Eight angular measurements were taken as following (Figure 2)[16-18]

1- SNA Angle

2- SNB Angle

3- ANB Angle

4- Y- Axis (Growth Axis)

5- Facial Axis (Modified Y-axis): The anterior angle were measured.[18]

6- Mandibular plane angle:

7- Sella Angle (Saddle Angle).

8- Gonial Angle.

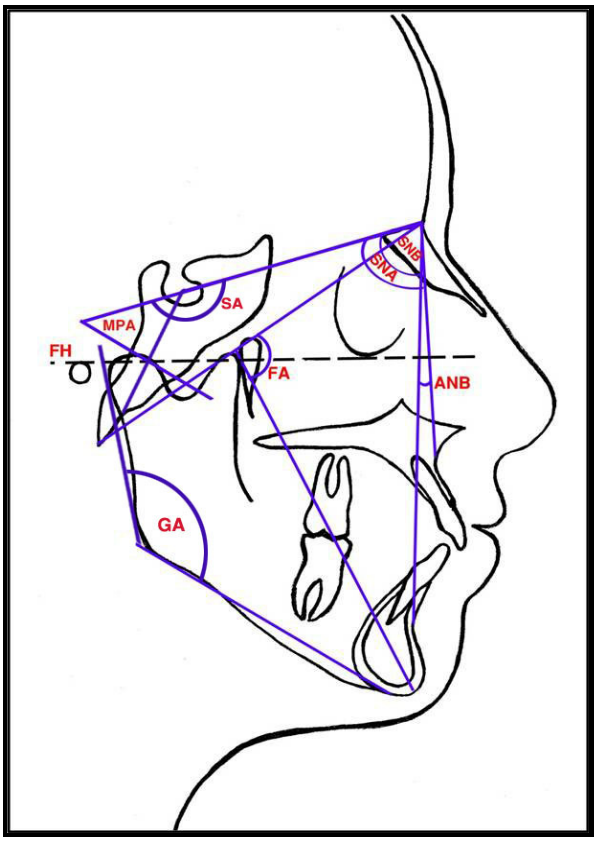

Figure 2: Angular Measurements. SNA, SNB, ANB, Facial Axis (FA), Mandibular Plane (MP), Sella angle (SA), Gonial angle (GA).

Proportional measurement (proportional of facial height):[17] It is a linear mililmetric assessment. The posterior face height (S-Go) and the anterior face height (N-Me). (Figure 1)

All statistical analysis were performed using SPSS (statistical package for social sciences) version 17. All values were expressed as means and standard deviation and compared by Anova test. A pairwise comparison was done by using Tukey test with cut of significance was taken at 5% (P <0.05).

RESULTS

Table 1 and 2 show the results obtained by linear, angular and proportional measurements. By using Anova and Tukey tests there was no statistical significant differences between the groups detected for the following values, distance A (P=0.959), distance B (P=0.938), distance C (P=0.903), SNA (P=0.315), SNB (P=0.904), ANB (P=0.499), Y-axis (P=0.859), facial axis (P=0.531), mandibular plane (P=0.108), sella angle (P=0.399).

The gonial angle values for group III was highly significant when compared with the control group (P=0.006). Lower facial height in group III was significantly less than the control group (P=0.03).

Table 1: Linear, Angular, and Proportional Measurements.

Measurements	Group I missing upper molars Mean ±SD	Group II missing lower molars Mean ±SD	Group III missing upper and lower molars Mean ±SD	Group 4 Control group Mean ±SD	F	P
Distance A	53.36±4.736	53.65± 4.056	53.00±2.734	53.45±4.979	0.083	0.959
Distance B	47.64±4.249	47.70±4.366	47.20±3.381	48.05±4.774	0.136	0.938
Distance C	76.41±7.430	77.80±6.940	77.15±4.356	76.60±6.754	0.191	0.903
SNA	76.77±6.294	79.40±3.747	78.55±3.818	78.05±3.818	1.202	0.315
SNB	74.64±7.352	75.75±3.823	75.35±3.183	72.30±3.672	0.189	0.904
ANB	2.59±3.096	3.65±2.519	3.20±2.546	2.75±.851	0.797	0.499
Y- axis	57.50±5.604	58.70±3.827	57.95±5.145	58.10±3.463	0.239	0.589
Modified Y-axis	89.64±4.489	90.50±3.487	88.15±7.829	88.90±4.090	0.742	0.531
Mand. Plane	38.41±5.o49	37.30±6.408	33.85±6.124	36.55±6.755	2.093	0.108
Sella angle	129.18±4.193	128.10±5.281	130.85±5.687	130.00±5.831	0.997	0.399
Gonial angle	124.70±6.760	124.50±6.109	120.15±6.098	126.50±5.458	4.011	0.010*
PFH/ AFH	61.20±5.268	61.05±5.031	63.95±3.776	60.05±3.684	2.866	0.042*

F: Anova test. *: P ≤ 0.05.

Table 2: Mean differences between 4 groups.

Variables		Control group	Group II	Group III
Distance A (ANS-PNS)	Group I	-0.086 ±1.307	- 0.286±1.307	0.364± 1.307
	Sig.	1.000	0.996	0.992
	Group II	0.200 ±1.338	—	0.650± 1.338
	Sig.	0.999		0.962
	Group III	-0.450 ± 1.338	—	—
	Sig.	0.987		
Distance B (A-PNS)	Group I	-0.414 ± 1.305	-0.064 ±1.305	0.436± 1.305
	Sig.	0.989	1.000	0.987
	Group II	-0.350 ±1.336	—	0.500± 1.336
	Sig.	0.994		0.982
	Group III	-0.850 ±1.336	—	—
	Sig.	0.920		
Distance C (Go-Pog)	Group I	-0.191±2.010	-1.391±2.010	-0.741±2.010
	Sig.	1.000	0.900	0.983
	Group II	1.200 ± 2.057	—	0.650± 2.057
	Sig.	0.937		0.989
	Group III	0.550 ± 2.057	—	—
	Sig.	0.993		
SNA angle	Group I	-1.277 ± 1.422	-2.627±1.422	-1.777± 1.422
	Sig.	0.806	0.259	0.597
	Group II	1.350 ±1.456	—	0.850± 1.456
	Sig.	0.790		0.937
	Group III	0.500 ±1.456	—	—
	Sig.	0.986		
SNB angle	Group I	-0.664 ±1.509	-1.114 ±1.509	-0.714± 1.509
	Sig.	0.971	0.882	0.965
	Group II	0.450 ± 1.545	—	0.400± 1.545
	Sig.	0.991		0.994
	Group III	0.050 ±1.545	—	—
	Sig.	1.000		
ANB angle	Group I	-0.159 ± 0.749	-1.059 ± 0.749	-0.609± 0.749
	Sig.	0.997	0.495	0.848
	Group II	0.900 ± 0.767	—	0.450± 0.767
	Sig.	0.645		0.936
	Group III	0.450 ± 0.767	—	—
	Sig.	0.936		

Y-axis	Group I	-0.600 ± 1.429	-1.200 ±1.429	-0.450 ± 1.429
	Sig.	0.975	0.835	0.989
	Group II	0.600 ±1.463	—	0.750 ± 1.463
	Sig.	0.977		0.956
	Group III	-0.150 ±1.463	—	—
	Sig.	1.000		
Modified Y-axis	Group I	0.736 ±1.617	-0.864 ±1.617	1.486 ± 1.617
	Sig.	0.968	0.950	0.795
	Group II	1.600 ±1.655	—	2.350 ± 1.655
	Sig.	0.769		0.491
	Group III	-0.750 ±1.655	—	—
	Sig.	0.969		
Mandibular plane angle	Group I	1.859 ±1.882	1.109 ±1.882	4.559 ± 1.882
	Sig.	0.757	0.935	0.081
	Group II	0.750 ± 1.927	—	3.450 ± 1.927
	Sig.	0.980		0.286
	Group III	-2.700 ±1.927	—	—
	Sig.	0.502		
Sella angle	Group I	-0.818 ±1.626	1.082 ±1.626	-1.668 ± 1.626
	Sig.	0.958	0.910	0.735
	Group II	-1.900 ±1.664	—	-2.750 ± 1.664
	Sig.	0.665		0.356
	Group III	0.850 ±1.664	—	—
	Sig.	0.956		
Gonial angle	Group I	1.800 ±1.887	2.000 ±1.887	-4.550 ± 1.931
	Sig.	0.776	0.715	0.094
	Group II	-0.200 ±1.931	—	4.350 ± 1.931
	Sig.	1.000		0.118
	Group III	6.350 ±1.887	—	—
	Sig.	0.006*		
Proportioanl facial height (PFH/AFH)	Group I	-1.155±1.383	-1.005 ± 1.383	2.750 ± 1.416
	Sig.	0.838	0.886	0.219
	Group II	-0.150±1.416	—	-2.900 ± 1.416
	Sig.	1.000		0.180
	Group III	-3.905±1.383	—	—
	Sig.	0.030*		

DISCUSSION

Massler et al[19] reported that third molar crypt formation begins at 3 to 4 years of age. Calcification starts at 7 to 10 years, and calcification of crown is completed at 12 to 16 years, eruption begins at 17 to 21 years. According to Gravely[7] and Grane[10] the possible time limit for the formation of the third molar germ is 13 years.

However, some reports of third molar development were late as 14 to 15 years.[20,21] Therefore, younger patients than 15 years were not included in the groups with agenesis to avoid the problem of false results.

Subjects with no history of previous orthodontic treatment were included in the sample to avoid possible effects of such treatment on the craniofacial complex. This coincide with Sanchez and colleagues study.[1]

Subjects with congenital deformities were also excluded as whose may involve sever irregularities in craniofacial development.[1,13,22,23]

In a study of a group of Japanese, Kajii and colleagues[13] evaluated the relationship of third molar agenesis to anteroposterior maxillary dimension. They reported that subjects with bilateral maxillary agenesis of third molar were associated with lesser sagittal dimensions of the maxilla. Nevertheless, no significant association was shown between the sagittal dimension of mandibular corpus and third molar agenesis.

The results of this study did not coincide with the results of Kajii study as significant differences between sagittal dimensions of maxilla and the mandible were not found in the four groups studied.

Another study presented by Kamak et al[23] reported that the percentage of third molar agenesis in skeletal class III was higher than that of skeletal class I and class II subjects.

Perhaps the difference between the result of this study, Kajii and Kamak results could be linked to racial differences (Japanese and Turkish) respectively, such differences are interesting and suggested that some polygenetic inheritance controlling maxillary dimensions and the formation of third molar germs may vary a cross different populations and races.[22,23]

The results in this study showing that no significant differences between the third molar agenesis and SNA, SNB, ANB, angles. These results did not coincide with the results presented by Kajii et al(13) they reported that the frequency of third molar agenesis significantly increased with decreasing ANB.

This difference in the results could be again referred to the racial differences. There have been some reporters(24,25) comparing the agenesis of third molars in different races. They reported that third molar agenesis in Mongolian population, including Japanese population, was higher than that in European American population. They also reported that the highest frequency of third molar germs existent was found in black subjects.

They speculated that one of reasons for these racial differences is that Mongolian population may had more skeletal class III patient who had small maxilla than European American population.(13) This racial difference explained the difference between the results which performed on Egyptian subjects and results reported by Kajii et al(13) which done on Japanese subjects and results reported by Kamak et al(23) which done on Turkish subjects.

The results of this study show no significance between the third molar agenesis, y-axis and facial axis in the four groups. Unfortunately, there have been few reports on the relationship between the third molar agenesis and facial structures.(22)

In a study of group of Spanish, Sanchez et al(1) showed that the mandibular plane angle was significantly less in the groups with maxillary and mandibular agenesis than the control group. In these results there was no statistical difference in mandibular plane angle between the four groups.

This difference in the results perhaps related to the difference in the age groups. In Sanchez study the age was between 13 to 19 years while in this study the age was ranged between 15-20 years. And to the difference in the method of classification of the groups. Sanchez et al(1) study included three groups while this study included four groups.

On the other hand, results of this study revealed decreased in the gonial angle, this reduction was statistically highly significant in group III as it compared to the control group.

This result coincided with the result revealed by Sanchez et al.[1] They found that the gonial angle was closed in both upper and lower group (group I, II) respectively.

Sanchez and colleagues[1] reported that the lower facial height was significantly less for mandibular agenesis group (group II) than in the control group. This was in agreement with this results that showed the proportional facial height (PFH) was significantly increased for group III than in the control group. This increasing in the proportional facial height indicated decrease in anterior facial height.

However, Kamak et al[23] reported that the third molar agenesis was the least for the subjects with hypodivergent pattern, and this was not in agreement with this study that revealed decrease in the goinal angle and anterior facial height in third molar agenesis groups.

The difference perhaps related to the difference in the age group, and the difference between races.

The reduction in the Proportional Facial Height and closed gonial angle are characteristic of horizontal growth pattern.[18]

As a clinical application of this results the reduction of the gonial angle and anterior facial height in group III can give a guide in anchorage planning.

The results support that there is a certain relationship between facial shape and third molar agenesis. Therefore this result is not conflict with the results of the previous work of Sanchez et al,[1] Kajii et al,[13,22] Kamak and Celikoglu.[23]

CONCLUSIONS

No relation between bilateral third molar agenesis and anteroposterior dimension of maxilla and mandible.

Subjects with upper and lower third molar agenesis showed decreased gonial angle, decreased anterior facial height, and mandibular morphology characterized by horizontal growth pattern.

REFERENCES

1. Sanchez M, Vicente A, Bravo L. Third Molar Agenesis and Craniofacial Morphology. Angle Orthod 2009; 79:473-478.
2. Salinas CF. Genetica Cranefacial. Washinton, DC: Organizacion panamericana de la Salud; 1979:256. (coated from Ref no.1)
3. McMillan A, Smman N, Chan D.W. Craniofacial profile in southern Chinese with hypodontia. Eur J Orthd 2009; 31:300-305
4. Bergendal B, Olgart K. Congenitally missing teeth in Koch G, Bergendal T, Kvint S et al.editors. Consensus conference on oral implants in young patients. Stockholm: Gothia; 1996. p.18.
5. Pilo R, Kaffe I, Amir E, Samat H. Diagnosis of developmental dental anomalies using panoramic radiographs. J Dent Child 1987;54:267-272
6. Polder BJ, Vant Hof M, Van der Linden F, Kuijpers-Jagtman A. Ameta-analysis of the prevalence of dental agenesis of permanent teeth. Comm Dent Oral Epidem 2004; 32:179-188.
7. Gravely JF. A radiographic survey of third molar development. British Dent J 1965; 119:397-401.
8. Nanda RS. Agenesis of third molar in man. Am J Orthod 1986; 40:698-706.
9. Daito M, Tanaka T, Hieda T. Clinical observations on the development of third molars. J Osaka Dent Univ. 1992; 26:91-104.
10. Garn SM, Lewis AB. The relationship between third molar agenesis and reduction in tooth number. Angle Orthod 1962; 32:270-279.
11. Barrachina C, Bravo A. Estudio de la morfologı´a cra´neofac en individuos con agenesia dentaria. Revista Espan˜-ola de Ortodoncia 1990; 20:229-236.
12. Yuksel S, Ucem T. The effect of tooth agenesis on dentofacial structures. Eur J Orthod 1997; 19:71-78.
13. Kajii T, Sato Y, Kajii S, Sugawara Y, Iida J. Agenesis of third molar germs depends on sagittal maxillary jaw dimension in orthodontic patient in Japan. Angle Orthod 2004; 74:337-342.

14. Bishara SE. Third molars: a dilemma! On the other hand, is it? Am J Orthod Dentofacial Orthop 1999; 115:628-633.
15. Ades AG, Joondeph DR, Little RM, Chapko MK. A long-term study of relationship of third molars to changes in the mandibular dental arch. Am J Orthod Dentofacial Orthop 1990; 97:323-335.
16. Proffit WR, Fields HW. Orthodontic diagnosis: The development of a problem list. In: Contemporary Orthodontics. 2nd ed. Chapter 6. USA Mosby, 1992. pp.139-185.
17. Graber TM, Petrovic AG. Cephalometric Diagnosis for Functional Appliance Therapy. Dentofacial Orthopedics with Functional Appliance. 3rd ed. Chapter 4. USA: Mosby, 1985. pp.92-110.
18. Ricketts RM. Perspective in the clinical application of cephalometrics. Angle Orthod 1981; 51:115-150.
19. Massler M, Schour I, Poncher HG.Developmental pattern of the child as reflected in the calcification pattern of the teeth. AmJ Dis Child 1941; 62:33-67.
20. Richardso ME. Late third molar genesis: its significance in orthodontic treatment. Angle Orthod 1980; 50:121-128.
21. Trisovic D, Markovic M, Starcevic M. Observations on the development of third mandibular molars. Eur Orthod Soc Trans 1977;147-157.
22. Kajii T, Lmai T, Kajii S, Lida J. Presence of third molar germs in orthodontic patients in Japan. Am J Orthod Dentofacial Orthp 2001; 119:245-250.
23. Kamak H, Celikoglu M, Patterns of third-molar agenesis in an orthodontic patient population with different skeletal malocclusions. Angle Orthod 2012; 82:165-169.
24. Brothwell DR, Carbonel VM, Goose DH. Congenital absence of teeth in human populations. In: Brothwell DR,editor. Dental anthropology. Oxford: Pergamon Press, 1963. pp.179-190.
25. Stewart RE. The dentition and anomalies of tooth size, form, structure, and eruption. In: Stewart RE, Barber TK, Troutman KC, Wei SHY (eds). Pediatric dentistry. St Louis (MO): Mosby; 1982. pp.87-110.