

Significance Of Various Etiological Factors As An Indicator For The Persistence Of Median Diastema

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Abstract: *Maxillary midline diastemas are a common esthetic problem that dentists must treat. This study was performed to quantify the width of median diastema and level of bone crest and to determine the type of inter-maxillary suture, familial prevalence, spacing in upper anterior region, axial inclination of upper central incisors, and low frenal attachment as the most contributing factors associated with median diastema. A standardized periapical radiographs using a paralleling technique with a film holder were taken to the (99) maxillary and/or mandibular central incisors with median diastema and to the (85) maxillary incisors with no diastema as a control group in adults with age range from 18-25 years old. Diastema width between 0.5-1 mm has a higher percent while diastema above 2 mm has a least percent. There is a non-significant difference in the level of alveolar crest of central*

incisor in both control and diastema groups. Type I intermaxillary suture type was the most common in control group while type II and III were the most common in diastema. There is a relationship between spacing and type of intermaxillary suture which can use as an indicator for the persistence of diastema from childhood in addition to familial history while frenum may has no effective role in developing median diastema. Axial inclination of central incisors is one of important factors that should be taken in consideration during treatment of median diastema

Introduction

Midline diastema defines as anterior midline spacing greater than 0.5 mm between the proximal surfaces of adjacent teeth [1], Maxillary midline diastema is a common esthetic problem in mixed and early permanent dentitions [2]. The prevailing view seems to consider its development as a multifactorial phenomenon [3],[4],[5],[6]. The space can occur either as a transient malocclusion or created by developmental, pathological or iatrogenical factors [2]. also maxillary anterior spacing, or diastemas, is a common esthetic complaint of patients. Although few entertainment celebrities have used a midline maxillary diastema as a successful trademark, many people find it esthetically displeasing. European adults with broad midline diastema were perceived as being less socially successful and of lower intelligence. Maxillary anterior spacing was equal to crowding and even more of an esthetic liability than excessive over jet or protruding incisors [6]. Midline diastema creates unpleasant appearance and interferes with speech depending on its width [7]. The need for treatment is mainly attributed to esthetic and psychological reasons, rather than functional ones [8]. Effective

diastema treatment requires correct diagnosis of its etiology and eliminating the underlying etiology along with closure of the diastema ensures greater stability and less chance of relapse [9],[10],[11]. This study try to assess level of alveolar crest and type of intermaxillary suture and some other factors in an adult Iraqi samples with median diastema as compared with others with no diastema.

Materials and methods

The samples were (184) adults (age range from 18-25 years old). The samples were selected from examined students of colleges of dentistry and medicine/University of Baghdad and the patients attending the orthodontic clinic, college of Dentistry, University of Baghdad. (85) of adults were with well-aligned natural maxillary central incisors considered as a control group. The remaining (99) adults with maxillary and/or mandibular midline diastema of more than 0.5 mm. All the samples should be with no history of previous orthodontic treatment, nor any artificial crown or proximal restoration in central incisors, without periapical and/or periodontal involvement and with all anterior teeth present to exclude any factors may create or change the width of midline diastema except in case of impacted canine which diagnosed by x-ray. The research samples were divided into male and female samples (table 1). The samples of diastema further divided into pure and extraction sub-samples (on the basis of whether there had been extraction of posterior teeth in the dental arch) (table 2). The examination included history taking, intra-oral examination and intra-oral periapical radiographs of the concerned incisor region were obtained for all samples using a paralleling technique with a long cone and film holder. To verify the radiographic magnification, a band and retainer was placed on the right central incisor of 10 subjects as an indicator of the magnification. There is a non-significant difference between real and image.

The following factors were studied in relation to the midline diastema: occurrence in maxillary and/or mandibular arches, gender, extraction of posterior teeth, familial prevalence (by

questioner), width of upper median diastema (diastema width was measured clinically with a filler gauge and vernier caliper at two levels: the mesio-incisal angles of the central incisors and five millimeters from the incisal line, the two measurements were averaged) [5]. Filler gauge is a special instrument of different blade thickness. Spacing in the anterior region, impaction of canine, axial inclination of upper central incisors, low frenal attachment (at or just above the gingival margin) [12]. level of alveolar crest (the vertical distance from bone crest to the proximal cemento-enamel junction of mesial surface of central incisor BC-PCEJ in periapical radiographs so when it above 2 mm, level of bone crest was considered below normal) [13], and inter-maxillary suture type in periapical radiographs. The inter-maxillary suture types were defined as follows [12]: (figure 1)

- Type I- normal V-shaped bone bisected by the inter-maxillary suture.
- Type II- normal bone with wider than normal open suture for approximately 2 mm (may be a shallow trough).
- Type III- spade-shaped bone between centrals bisected by an intermaxillary suture.
- Type IV- W-shaped bone with a deep open suture.

Level of alveolar bone crest and type of inter-maxillary suture in the diastema sample compared with control sample. Level of bone crest and type of inter-maxillary suture were measured and determined by magnification viewer.

Table 1: Description of research samples.

Control group			Diastema group		
<i>male</i>	<i>female</i>	<i>total</i>	<i>male</i>	<i>female</i>	<i>total</i>
41	44	85	53	46	99

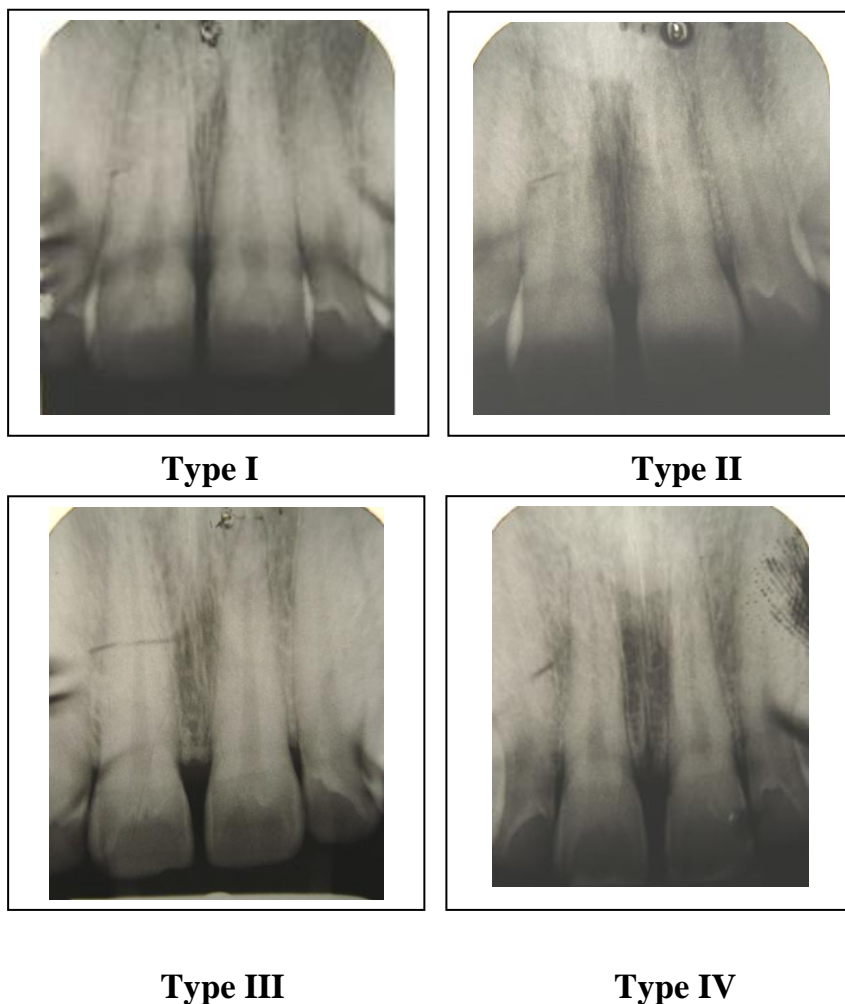


Figure 1: Types of Intermaxillary Suture

Results

Table 2 shows the distribution of midline diastema in maxillary and/or mandibular arches. Because of the small sample size in the mandible and in both arches of both genders, so they would be excluded from discussion. Despite the percent of prevalence of diastema in both purified and extraction maxillary

group of female greater than male, the number of diastema in both gender nearly similar, but because of the small sample size in the extraction group of maxillary diastema, the data in this group should be interpreted with caution.

Factors associated with maxillary median diastema are demonstrated in details in table 3. The percent of familial prevalence in male (53.7%) and in female (42.9%) and in total (47.8%) of the research sample which is high percent. In both genders of purified maxillary diastema and in the total group, width between 0.5-1 mm has a higher percent than diastema width from 1-1.5 mm which has more percent than diastema width from 1.5-2 mm. Diastema width above 2 mm has a least diastema percent. In female, diastema width of extracted sub-group has the same percent from 0.5-2 mm.

The percentage of spacing between six anterior teeth is (32.2%) which is greater than percentage of spacing between four anterior teeth (12.2%) and in male more than female. 40 Of 90 of sample which is equal to (44.4%) having spacing in upper anterior region. impacted canine appear on male only with (4.9%).

Straight axial inclination of central incisors is most common type (56.7%) with midline diastema then diverge axial inclination (35.6) and least one is converge axial inclination (7.8%). Percent of low frenal attachment is very small (5.6%).

Regarding to the level of bone crest from the proximal CEJ, (94.4%) of the sample was within normal and (5.6%) was below normal (table 3). Statistically, there is a statistical non-significant difference between control and diastema groups. Mean of BC-CEJ is (0.648 mm) in control and (0.669 mm) in diastema. While there was a statistical significant differences between male and female in both control and diastema groups. The level of bone crest in male is below than that of female but both were within normal level (table 4).

Prevalence of intermaxillary suture types in control and purified maxillary diastema groups is demonstrated in table 5. Type II and type III are the most common in male and female respectively in purified maxillary diastema group and they were the most predominant types in this group while type I was the predominant one in control group. There was a statistical significant difference in the intermaxillary suture types between control and diastema groups in male, female and total. But there is a non-significant gender differences in both control and diastema groups (table 6).

There is an association between anterior spacing and types of suture. More spacing occur with type II and type III in male but more spacing occur with type IV in female. In total most percent of spacing occur with type II then type IV then type III. The least percentage of spacing occurs with type I (table 7).

Table 2: distribution of midline diastema according to dental arches

Dental arches	Male		female		total
	Pure	extraction	pure	extraction	
<i>maxillary diastema</i>	<i>n=47</i> n=41 83.7%	<i>n=6</i> n=4 66.7%	<i>n=43</i> n=42 97.7%	<i>n=3</i> n=3 100%	<i>n=99</i> n=90 90.9%
<i>Mandibular diastema</i>	n=2 4.1%	n=0	n=0	n=0	n=2 2.0%
<i>both arches</i>	n=4 8.5%	n=2 33.3%	n=1 2.3%	n=0	n=9 9.1%

Table 3: Factors associated with maxillary midline diastema

Factors	Male		female		total
	Pure	extraction	Pure	extraction	
	<i>n=41</i>	<i>n=4</i>	<i>n=42</i>	<i>n=3</i>	
<i>familial prevalence</i>	<i>n=22</i> 53.7%	<i>n=2</i> 50.0%	<i>n=18</i> 42.9%	<i>n=1</i> 33.3%	<i>n=43</i> 47.8%
<i>width of upper median diastema</i>					
0.5--1 mm	<i>n=18</i> 43.9%	<i>n=2</i> 50.0%	<i>n=24</i> 57.1%	<i>n=1</i> 33.3%	<i>n=45</i> 50.0%
1--1.5 mm	<i>n=13</i> 31.7%	<i>n=1</i> 25.0%	<i>n=10</i> 23.8%	<i>n=1</i> 33.3%	<i>n=25</i> 27.8%
1.5--2 mm	<i>n=6</i> 14.6%	<i>n=1</i> 25.0%	<i>n=7</i> 16.7%	<i>n=1</i> 33.3%	<i>n=15</i> 16.7%
more than 2 mm	<i>n=4</i> 9.8%	<i>n=0</i>	<i>n=1</i> 2.4%	<i>n=0</i>	<i>n=5</i> 5.6%
<i>spacing in upper anterior region</i>					
between 4 ant. Teeth	<i>n=7</i> 17.1%	<i>n=0</i>	<i>n=4</i> 9.5%	<i>n=0</i>	<i>n=11</i> 12.2%
between 6 ant. Teeth	<i>n=22</i> 53.7%	<i>n=1</i> 25.0%	<i>n=6</i> 14.3%	<i>n=0</i>	<i>n=29</i> 32.2%
<i>impacted canine</i>	<i>n=2</i> 4.9%	<i>n=0</i>	<i>n=0</i>	<i>n=0</i>	<i>n=2</i> 2.2%
<i>axial inclination of upper central incisors</i>					
straight	<i>n=26</i> 63.4%	<i>n=2</i> 50.0%	<i>n=23</i> 54.8%	<i>n=0</i>	<i>n=51</i> 56.7%
diverge	<i>n=12</i> 29.3%	<i>n=2</i> 50.0%	<i>n=16</i> 38.1%	<i>n=2</i> 66.7%	<i>n=32</i> 35.6%
converge	<i>n=3</i> 7.3%	<i>n=0</i>	<i>n=3</i> 7.1%	<i>n=1</i> 33.3%	<i>n=7</i> 7.8%
<i>Low frenal attachment</i>	<i>n=4</i> 9.8%	<i>n=0</i>	<i>n=1</i> 2.4%	<i>n=0</i>	<i>n=5</i> 5.6%
<i>level of alveolar crest in periapical radiographs</i>					
within normal	<i>n=38</i> 92.7%	<i>n=4</i> 100%	<i>n=40</i> 95.2%	<i>n=3</i> 100%	<i>n=85</i> 94.4%
below normal	<i>n=3</i> 7.3%	<i>n=0</i>	<i>n=2</i> 4.8%	<i>n=0</i>	<i>n=5</i> 5.6%
<i>intermaxillary suture in periapical radiographs</i>					
type I	<i>n=7</i> 17.1%	<i>n=0</i>	<i>n=5</i> 11.9%	<i>n=0</i>	<i>n=12</i> 13.3%
type II	<i>n=14</i> 34.1%	<i>n=1</i> 25.0%	<i>n=12</i> 28.6%	<i>n=0</i>	<i>n=27</i> 30.0%
type III	<i>n=11</i> 26.8%	<i>n=3</i> 75.0%	<i>n=18</i> 42.9%	<i>n=3</i> 100%	<i>n=35</i> 38.9%
type IV	<i>n=9</i> 22.0%	<i>n=0</i>	<i>n=7</i> 16.7%	<i>n=0</i>	<i>n=16</i> 17.8%

Table 4: Group and gender differences in bone level (mm) of control and diastema of purified maxillary sub-group.

	group difference		gender difference			
	<i>control</i>	<i>diastema</i>	control & diastema			
			<i>male</i>	<i>female</i>	<i>male</i>	<i>female</i>
N	85	83	41	44	41	42
Mean	0.648	0.669	0.709	0.590	0.824	0.516
SD	0.25	0.57	0.23	0.25	0.76	0.32
t-test	0.330		2.443		0.2755	
p-value	0.742		0.017		0.008	

Table 5: Prevalence of intermaxillary suture types in control and purified maxillary diastema groups.

Intermaxillary suture	Control Group						Diastema Group					
	<i>male n=41</i>		<i>female n=44</i>		<i>total n=85</i>		<i>male n=41</i>		<i>female n=42</i>		<i>total n=83</i>	
	<i>n</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
type I	23	56.09	21	47.72	44	51.76	7	17.07	5	11.90	12	14.45
type II	5	12.19	7	15.90	12	14.11	14	34.14	12	28.57	26	31.32
type III	7	17.07	9	20.45	16	18.82	11	26.82	18	42.85	29	34.93
type IV	6	14.63	7	15.90	13	15.29	9	21.95	7	16.66	16	19.27

Table 6: Chi-square for the prevalence of intermaxillary suture types according to presence of diastema and gender.

	difference between control & diastema			gender difference	
	<i>male</i>	<i>female</i>	<i>total</i>	<i>control</i>	<i>diastema</i>
X²	14.285	14.123	27.49	0.646	2.415
d.f.	3	3	3	3	3
p level	0.003	0.003	0.000	0.886	0.491

Table 7: Association of suture types in purified maxillary diastema sub-group with the spacing between anterior teeth

intermax. suture	Ant. Spacing in male		Ant. Spacing in female		Ant. Spacing in total	
	n	%	n	%	n	%
Type I	2	28.6	0		2	16.7
Type II	12	85.7	3	25.0	15	57.7
Type III	10	90.9	4	22.2	14	48.3
Type IV	5	55.6	3	42.9	8	50.0

Discussion

This is not the first Iraqi study conducted to evaluate the contributing factors for median diastema but the first one concern bone crest level and types of intermaxillary suture and their significance in prediction of persistence of median diastema and compare with control without diastema.

The midline diastema occurs predominantly in the purified maxillary arch in both genders which may be due to young age of the sample that lead to small sample size in extracted group compared with the purified one, furthermore most of the contributing factors of median diastema appear in the upper rather than lower jaw. Greater emphasis on statistic and discussion has been given to the purified maxillary median diastma sub-group. The prevalence of the diastema in female was more than male. This result disagree with Nainar and Gnanasundaram [5] and Al-Huwaizi [14] which found that the prevalence of midline diastema in male more than female. Genetic factors most likely play a leading role in male-female differences. Omotoso and Kadir was found that maxillary midline diastema occurs more frequently than mandibular midline diastema, and that females are more likely to have a maxillary midline diastema, while males are more likely to have a mandibular midline diastema. Diastema runs in families, and it is suggested that male children are more likely to inherit it [15].

The relatively high prevalence of familial occurrence led to propose the presence of a genetic factor contributing to midline diastema expression. The heredity may play a greater role than environment in the development of such malocclusions [5], [16]-[18]. There is a rare cyst originating from epithelium trapped along the line of fusion of the lateral palatal maxillary processes during development. Incomplete palatal fusion is a possible cause of the persisting midline diastema. This cystic formation may be related to family history, a fact indicating genetic influences [19]. The family tree of diastema was one of the three important risk factors for diastema relapse after orthodontic correction. The other factors were width of diastema before treatment and the presence of additional spacing in the maxillary anterior segment [17].

The occurrence of spacing between both (upper 4 and 6 anterior teeth) which equal to (44.4%) of the total sample of diastema group confirm the suggestion of other authors that the spacing between upper anterior teeth is the primary cause of the persistence of the maxillary diastema [5],[12],[20],[21]. This may be due to the greater incidence of spacing in the anterior region of maxilla compared with the other areas of the mouth [22]. Spacing result from tooth-size discrepancies which one of the main causes for maxillary midline diastema [6],[23]. Tooth-size discrepancies demonstrate as small size anterior teeth or peg-shaped maxillary lateral incisors that allow distal drifting of the maxillary central incisors because of lack of proximal support. Others lack mesially directed forces due to impacted canine or displaced teeth and create a median diastema. Impacted canine are more common in male than female. This result comes in similar with Nainar and Gnanasundaram [5].

Straight axial inclination of central incisors with midline diastema has the highest percentage among the three types. This finding compatible with Hashim [24] who found that the straight axial inclination of central incisors is an important contributing factors of median diastema in class I malocclusion. The axial inclination of the central incisors is one of the critical factors that

the dentist must evaluate when contemplating treatment for midline diastema since the mesiodistal crown angulations influence the amount of arch length or space between the cuspid. Less maxillary arch circumference is present when the incisors are upright and more arch length or arch circumference is increased when the crowns are angulated. Therefore, the more upright the crowns, the greater the possibility was of anterior spacing.

Because of the small percent of low frenal attachment associated with maxillary median diastema, so there is no strong correlation between abnormal frenum and the presence of median diastema. This result agrees with others [5],[25],[26]. There is disagreement as to whether abnormal frenum is cause or effect. In infant, the frenum appears thick and short and is typically attached to incisive papilla [27],[28]. With growth, the frenum does not usually follow the downward development of the alveolar process concomitant with tooth eruption. One theory is that thick frenum disrupt the transpalatal fiber attachment and prevent closure of the developmental diastema [29],[30]. Another is that the labial frenum persists due to the existing diastema and because the dentition applies little or no pressure on the tissues, there is little or no atrophy of the frenum [12],[31]. According to this study, low frenal attachment was not the major etiological factor causing midline spacing.

The non-significant difference in the level of alveolar crest of central incisor in both control and diastema groups indicates there is no correlation between bone level and median diastema. This finding disagrees with Nainar and Gnanasundaram⁵ who concluded that the tendency for the alveolar crest to be below the cervical line suggests a possible bone factor in the etiology of midline diastema. The difference with the result of present study may be due to wider range of age of sample which was from 13-35 years and because high percent of level of alveolar crest below cervical line appeared in extraction groups.

The control group shows that intermaxillary suture type I occur most frequently in male, female and total and the percent of this type in this group around 50% as compared with diastema group which is around 14%. Furthermore, in diastema group, type II suture most frequent in male and type III in female. Type II and type III intermaxillary suture most common types associated with diastema followed by type IV (table 5). According to this result and the result of Popovich et al [12] who found suture type remain more constant through development, so the assessment of persistence of diastema through adulthood can be done from type of intermaxillary suture during childhood in most children. Popovich et al [12] studied suture types in children at age 9 and again at age 16 and found type II associated with diastema while Nainar and Gnanasundaram [5] found type I most common in both the sexes. As the least percentage of spacing occur with type I, and the most percent of spacing occur with type II then type IV then type III. That means spacing may be responsible for the appearance of type II, III, and IV suture nor frenum.

Conclusion

1. There is almost no limiting contributing factors with persisting midline diastema.
2. Undoubtedly, hereditary causes are high up the list.
3. Maxillary anterior spacing is one of the risk factor cause the diastema and may be related to the intermaxillary suture types which should include in the assessment of any child.
4. intermaxillary suture types and spacing during childhood can be used as an indicator for the persistence of median diastema in the adulthood.
5. There is no association between the level of frenal attachment and of alveolar crest of central incisor with diastema.
6. Effective diastema treatment requires correct diagnosis of its etiology and intervention relevant to the specific etiology.

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أهمية العوامل المسببة المختلفة كمؤشر لاستمرار الفراغ الأوسط

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جامعة بغداد / كلية طب الأسنان

المستخلص

الفراغ الأوسط العلوي يشكل مشكلة جمالية شائعة يجب على أطباء الأسنان معالجتها. وقد أجريت هذه الدراسة لتحديد عرض الفراغ الأوسط للأسنان ومستوى قمة العظم وإلى تحديد نوع الشق بين جزئي الفك العلوي، والانتشار العائلي، والفراغات في المنطقة الأمامية العليا، والميل المحوري للقواطع العليا، والرابط الفعال المنخفض باعتبارها أكثر العوامل المرتبطة مع الفراغ الأوسط للأسنان. وقد تم أخذ صور أشعه ذروية موحدة باستخدام تقنية موازاة مع حامل الفيلم إلى (٩٩) فراغ أوسط بين القواطع المركزية في الفك العلوي و/أو الفك السفلي، و (٨٥) قاطع في الفك العلوي بدون فراغ أوسط واعتبارها مجموعة ضابطة لعينة من البالغين تتراوح أعمارهم من (18 إلى ٢٥ سنة). وأظهرت النتائج أن عرض الفراغ الأوسط الذي يتراوح بين ٠ - ١,٥ ملم لديه أعلى نسبة مئوية في حين أن الفراغ الأوسط الذي تكون قيمته أعلى من ٢ ملم لديه أقل نسبة مئوية. هناك فرقا غير ملحوظ في مستوى قمة العظم للقواطع الأمامي في كل من المجموعتين. النوع الأول للشق في الفك العلوي كان الأكثر شيوعا في المجموعة الضابطة بينما النوع الثاني والثالث هما الأكثر شيوعا في مجموعة الفراغ الأوسط. هناك علاقة بين الفراغات في الفك العلوي ونوع الشق العلوي والتي يمكن استخدامها كمؤشر لاستمرار وجود الفراغ الأوسط للأسنان من مرحلة الطفولة، بالإضافة إلى التاريخ العائلي في حين الرابط الفعال ليس له دور فعال في تنمية الفراغ الأوسط. أما الميل المحوري للقواطع المركزية هي واحدة من العوامل المهمة التي ينبغي أخذها في الاعتبار أثناء علاج الفراغ الأوسط.