Incidence and etiology of midline diastema in a population in South India (Madras)

By S.M. Hashim Nainar, BDS and N. Gnanasundaram, MDS

A diastema is defined as a space greater than 0.5 millimeter between the proximal surfaces of adjacent teeth.[1] In a study of North American Caucasoid males aged 17-25 years, Keene found the incidence of maxillary midline diastemas to be 14.8 percent and the mandibular midline diastemas to be 1.6 percent.

Lavelle[2] in a study of diastemas in different population samples aged 18-25 years in United Kingdom found the incidence of maxillary midline diastemas to be 3.4 percent in Caucasoids, 5.5 percent in Negroids and 1.7 percent in Mongoloids and the incidence of mandibular midline diastemas to be 0.8 percent in Caucasoids, 2.3 percent in Negroids and 0.6 percent in Mongoloids.

Steigman and Weissberg[3] in a study of spaced dentitions in Israeli adolescents (12-18 years) found the incidence of maxillary midline diastemas to be 25.4 percent in spaced dentitions and 1.4 percent occurring alone; the incidence of mandibular midline diastemas in spaced dentitions was 3.5 percent and 0.2 percent occurring alone. Simultaneous occurrence in both the arches was 6.3 percent in spaced dentitions.

No definite etiology for midline diastema has been identified. Angle's[4] suggestion of abnormal frenum as the cause of midline diastema has been supported by McCoy[5], Stones[6], Sicher[7] and others. Tait[8] stated that the frenum is an effect and not a cause of the diastema. Dewel[9] stated that a truly abnormal frenum is rare and Ceremello[10] in a study involving two groups of 17 patients each, one with diastema and the other without diastema concluded that the character of the frenum is not correlated with the presence or width of diastema. Other causes suggested include missing or undersized lateral incisors; parafunctional habits such as thumb-sucking, mouth-breathing and tongue-thrusting; mesiodens; ankylosed central incisor; flared or rotated central incisors; anodontia; macroglossia; dento-alveolar disproportion; localized

Abstract

In a cross-sectional study of midline diastemas in a South Indian (Madras) population, 9,774 patients aged 13-35 years were screened. True midline diastema was defined as one without periodontal/periapical involvement and with the presence of all anterior teeth in the arch. Sample purification resulted in a research sample of 166 patients with true midline diastemas. The incidence of true maxillary midline diastema (160/9774 — 1.6%) was greater than that of true mandibular midline diastemas (31/9774 — 0.3%). No direct etiologic factor for the midline diastemas was noted. Spacing in the anterior region was the most significant factor associated with the midline diastema.

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Key Words

Incidence • Midline • Diastema • India

Table 1
The bold numbers indicate actual data.

Table 1

Cases Excluded from Research Sample

Cause of exclusion	13-20 years n = **112**		21-28 years n = **105**		29-35 years n = **34**		Total n = **251**	
Periodontal involvement	**19**	17.0%	**24**	22.9%	**5**	14.7%	**48**	19.1%
Periapical involvement	**7**	6.3%	**5**	4.8%	**2**	5.9%	**14**	5.6%
Both periapical and periodontal involvement	**4**	3.6%	**2**	1.9%	**1**	2.9%	**7**	2.8%
Lack of radiographs	**4**	3.6%	**8**	7.6%	**4**	11.8%	**16**	6.4%
Total	**34**	30.4%	**39**	37.1%	**12**	35.3%	**85**	33.9%

spacing; closed bite; facial type; ethnic and familial characteristic; inter-premaxillary suture; and midline pathology.[11-17]

The purpose of the present study was to determine the incidence of midline diastemas in South India (Madras) and the various factors associated with the midline diastema.

Materials and methods

A random sample of patients aged 13-35 years attending the Oral Diagnosis department of the Madras Dental College Hospital were screened for midline diastemas. Patients under 13 years were excluded to avoid cases of midline diastema due to the normal stages of development. Patients above 35 years were excluded to avoid cases of midline diastema due to migration of teeth and progressive periodontal disease.

A total of 9,774 patients were screened; those with clinical evidence of supragingival calculus and suspected periodontal involvement were excluded. Also excluded were cases with incisor/canine tooth extraction in the arch with the midline diastema. Two hundred fifty-one cases of midline diastema of more than 0.5 millimeter in width were selected (raw sample). None of the 251 patients were related. The examination included history-taking, intra-oral examination and an intra-oral periapical radiograph of the concerned incisor region. The examinations were all done by the same observer. The intermaxillary suture typing was also done by a single observer. Diastema widths were measured clinically with Vernier calipers at two levels: the mesio-incisal angles of the central incisors and five millimeters from the incisal line. The two measurements were averaged.

The raw sample was purified by the exclusion of cases with radiographic evidence of periodontal and/or periapical involvement and cases without radiographs. An arbitrary division of the sample into three age groups, 13-20 years, 21-28 years and 29-35 years was done to note the cause of exclusion and possible relation to age.

Patients with periodontal disease or periapical pathology, and those with incisor or canine tooth extraction were excluded because of the potential that these factors might have created or changed the width of the midline diastema. This resulted in a research sample with true midline diastemas defined as midline diastemas in arches without periapical/periodontal involvement and with all anterior teeth present.

The research sample was divided into male and female samples and further divided into pure and extraction sub-samples (on the basis

Table 2
The bold numbers indicate actual data. "Pure" refers to the sample without any tooth extraction; "Extraction" refers to the sample with posterior tooth extraction in the arch.

Table 2

Description of Research Sample

Arch Description	Male n = **89**		Female n = **77**		Total n = **166**	
Pure	**75**	84.3%	**61**	79.2%	**136**	81.9%
Extraction	**14**	15.7%	**16**	20.8%	**30**	18.1%

Table 3

Incidence of Midline Diastemas in Maxillary/Mandibular Arches

Dental Arch	Male				Female				Total	
	Pure n = 76		Extn n = 17		Pure n = 61		Extn n = 22		n = 176	
Maxillary	**61**	80.3%	**14**	82.4%	**55**	90.2%	**15**	68.2%	**145**	82.4%
Mandibular	**5**	6.6%	**3**	17.6%	**2**	3.3%	**6**	27.3%	**16**	9.1%
Both arches	**10**	13.2%	—		**4**	6.6%	**1**	4.5%	**15**	8.5%

Table 3
The bold numbers indicate actual data. "Pure" refers to arches without extraction; "Extn" refers to arches with posterior tooth extraction. These indicate occurrences only. In cases of midline diastemas in both the arches with extraction in one arch, the arch with extraction was included in the extraction sample and the arch without extraction in the pure sample.

of whether there had been extraction of a posterior tooth in the dental arch) to find the significance of tooth extraction and loss of proximal contacts. (In cases of midline diastemas in both the arches with extraction in one arch, the arch with extraction was included in the extraction sample and the arch without extraction was included in the pure sample.) None of the patients in the extraction sample had prosthodontic replacement of extracted teeth.

The following factors were studied in relation to the midline diastema in the purified research sample: familial incidence (derived from history-taking); parafunctional habits (thumb-sucking and tongue-thrusting); mouth breathing; microdontia of lateral incisor; absence of lateral incisor; absence of canine; impaction of canine; mesiodens; high frenal attachment (presence of frenum from labial alveolus to incisal papilla); axial inclination of central incisor teeth (based on orientation of incisor axes in the periapical film); spacing in the anterior region; class of occlusion (molar relation); type of overbite (based on overbite measured with teeth in occlusion (open — negative; closed — positive; deep bite — palatal occlusion of mandibular incisors); and inter-maxillary suture type in the periapical radiographs. The inter-maxillary suture types were defined as follows:[18] Type I — normal V-shaped bone bisected by the inter-maxillary suture; Type II — normal bone with a wider than normal open suture (may be a shallow trough); Type III — spade-shaped bone bisected by inter-maxillary suture; Type IV — W-shaped bone with a deep open suture.

Results

Of the 251 cases selected, 85 (33.9 percent) were excluded during purification of the research sample. Periodontal disease was the major cause of exclusion though there was no clinically significant difference in the percentage excluded in each age group (Table 1).

There is a similar though slightly greater incidence of midline diastema in males than in females, with the pure sample constituting a greater percentage than the extraction sample in both the sexes. Because of the small sample size in the extraction group, data in this group should be interpreted with caution (Table 2).

The incidence of true maxillary midline diastemas in this population is 1.6 percent (160/9774) and true mandibular midline diastemas is 0.3 percent (31/9774). Midline diastema occurs predominantly in the maxillary arch in both sexes; both maxillary midline diastemas and the simultaneous occurrence of midline diastemas in both arches are greater in males (Table 3).

In both sexes, diastema widths between 1.5-3.0 millimeters are slightly more prevalent than 0.5-1.5 millimeters in the maxillary arch; in the mandibular arch, diastema widths between 0.5-1.5 millimeters are more prevalent. In both the sexes, diastema widths above 3.0 millimeters are least prevalent in both the maxillary and mandibular arches. The width of midline dia-

Table 4
The bold numbers indicate actual data. "Pure" refers to arches without any extraction; "Extn" refers to arches with posterior tooth extraction. These indicate occurrences only. In cases of midline diastemas in both the arches with extraction in one arch, the arch with extraction was included in the extraction sample and the arch without extraction in the pure sample.

Table 4

Width of the Maxillary/Mandibular Midline Diastema

Width of Midline diastema	Male		Female		Total
	Pure	Extn	Pure	Extn	
Maxillary:	n = **71**	n = **14**	n = **59**	n = **16**	n = **160**
0.5 mm — 1.5 mm	**29** 40.8%	**5** 35.7%	**22** 37.3%	**8** 50.0%	**64** 40.0%
1.5 mm — 3.0 mm	**31** 43.7%	**7** 50.0%	**31** 52.5%	**8** 50.0%	**77** 48.1%
Above 3.0 mm	**11** 15.5%	**2** 14.3%	**6** 10.2%	—	**19** 11.9%
Mandibular:	n = **15**	n = **3**	n = **6**	n = **7**	n + **31**
0.5 mm — 1.5 mm	**8** 53.3%	**2** 66.7%	**5** 83.3%	**4** 57.1%	**19** 61.3%
1.5 mm — 3.0 mm	**5** 33.3%	**1** 33.3%	**1** 16.7%	**3** 42.9%	**10** 32.3%
Above 3.0 mm	**2** 13.3%	—	—	—	**2** 6.5%

stema in the extraction sample shows a trend similar to the pure sample (Table 4).

In most cases, no single etiologic factor was attributable, hence only occurrences have been noted; one patient could have two or more of these factors. Spacing in the anterior region is the most significant factor (51.8 percent) in association with the midline diastema. Also, significant are familial incidence (32.5 percent) and parafunctional habits (29.5 percent). Other factors with greater than 5.0 percent incidence in the sample include high frenal attachment (14.5 percent) and microdontia of lateral incisor (10.2 percent).

Microdontia of lateral incisor appears to be more common in females. Straight axial inclination of the central incisors is most common (88.0 percent) in all the research sub-samples. Closed type of overbite (81.3 percent) is more common than deep overbite (11.5 percent) and anterior openbite (7.2 percent). Class I occlusion (molar relation) is prevalent in both the sexes. No case with Class II Division 2 occlusion was seen though two males and one female showed Class II Division 1 occlusion. Only five males and four females showed Class III occlusion. There appears to be a greater tendency for the alveolar crest in periapical radiographs to be below the cervical line in relation with the midline diastema (Table 5).

Inter-maxillary suture Type I is most common in both the sexes (45.0 percent), the other types having a similar average incidence (Table 6).

Discussion

A significant exclusion (33.9 percent) of the raw sample during purification emphasizes the need for radiographic examination after clinical screening to achieve a research sample free of periodontal/periapical involvement. Although all age groups showed similar percentages of exclusion during purification, the significantly reduced sub-sample size in the 29-35 year age group suggests increased periodontal involvement that might have resulted in increased case exclusion during the clinical screening.

The incidence of maxillary midline diastemas is considerably less in this population compared to the Caucasoid, Negroid and Israeli populations; it is similar to the Mongoloid population. The mandibular midline diastema is the least in this population compared to the other populations studied by Keene[1], Lavelle[2], and Steigman and Weissberg[3]. There is no apparent difference between the pure and extraction samples in the size (width) of the midline diastema in both the sexes. Straight axial inclination of the central incisor teeth is predominant in relation with the midline diastema. The above-mentioned factors are suggestive of non-correlation of incidence of midline diastema and tooth movement due to loss of appositional contact following posterior tooth extraction.

A significant familial incidence suggests a possible genetic factor. A significant but marginal incidence of high frenal attachment is in line with the concept of a rare abnormal frenum and more common passive frenal attachment. A sig-

Table 5

Factors Associated with the Midline Diastema

Factors	Male				Female				Total	
	Pure n = 75		Extn n = 14		Pure n = 61		Extn n = 16		n = 166	
Familial incidence	**25**	33.3%	**5**	35.7%	**19**	31.2%	**5**	31.3%	**54**	32.5%
Parafunctional habits	**26**	34.7%	**4**	28.6%	**17**	27.9%	**2**	12.5%	**49**	29.5%
Microdontia of lateral incisor	**5**	6.7%	**1**	7.1%	**11**	18.0%	—		**17**	10.2%
Absence of lateral incisor	**5**	6.7%	—		**1**	1.6%	—		**6**	3.6%
Absence of canine	**1**	1.3%	—		**1**	1.6%	—		**2**	1.2%
Impaction of canine	**4**	5.3%	—		—		**1**	6.3%	**5**	3.0%
Mesiodens	**4**	5.3%	—		**2**	3.3%	—		**6**	3.6%
High frenal attachment	**11**	14.7%	**1**	7.1%	**11**	18.0%	**1**	6.3%	**24**	14.5%
Axial inclination of central incisor teeth:										
Straight	**64**	85.3%	**11**	78.6%	**58**	95.1%	**13**	81.3%	**146**	88.0%
Convergent	**9**	12.0%	**2**	14.3%	**2**	3.3%	**2**	12.5%	**15**	9.0%
Divergent	**2**	2.7%	**1**	7.1%	**1**	1.6%	**1**	6.3%	**5**	3.0%
Spacing in the anterior region	**42**	56.0%	**5**	35.7%	**35**	57.4%	**4**	25.0%	**86**	51.8%
Type of overbite:										
Anterior open bite	**6**	8.0%	**1**	7.1%	**3**	4.9%	**2**	12.5%	**12**	7.2%
Closed overbite	**59**	78.7%	**12**	85.7%	**50**	82.0%	**14**	87.5%	**135**	81.3%
Deep overbite	**10**	13.3%	**1**	7.1%	**8**	13.1%	—		**19**	11.5%
Level of alveolar crest in periapical radiographs*:	n = 86		n = 17		n = 65		n = 23		n = 191	
At cervical line	**45**	52.3%	**5**	29.4%	**27**	41.5%	**6**	26.1%	**83**	43.5%
Below cervical line	**41**	47.7%	**12**	70.6%	**38**	58.5%	**17**	73.9%	**108**	56.5%

**These indicate occurrences only. In cases of midline diastemas in both the arches with extraction in one arch, the arch with extraction was included in the extraction sample and the arch without extraction in the pure sample.*

Table 5
The bold numbers indicate actual data. "Pure" refers to arches without any extraction; "Extn" refers to arches with posterior tooth extraction. These indicate occurrences only; one patient could have two or more of these factors.

Table 6

Intermaxillary Suture in the Research Sample

Intermaxillary suture	Male				Female				Total	
	Pure n = 71		Extn n = 14		Pure n = 59		Extn n = 16		n = 160	
Type I	**34**	47.9%	**9**	64.3%	**18**	30.5%	**11**	68.8%	**72**	45.0%
Type II	**18**	25.4%	—		**14**	23.7%	—		**32**	20.0%
Type III	**9**	12.7%	**2**	14.3%	**12**	20.3%	**4**	25.0%	**27**	16.9%
Type IV	**10**	14.1%	**3**	21.4%	**15**	25.4%	**1**	6.3%	**29**	18.1%

Table 6
Suture typing was done following the method of Popovich et al.[18] The bold numbers indicate actual data. "Pure" refers to arches without any extraction; "Extn" refers to arches with posterior tooth extraction.

nificant occurrence of deep overbite indicates a possible etiologic factor in the incidence of midline diastema. The tendency for the alveolar crest to be below the cervical line suggests a possible bone factor in the etiology of midline diastema.

This study also could not focus on the precise etiology of midline diastema. Spacing in the anterior region appears to be a significant factor associated with midline diastema in this study and others.[3,18] Lavelle and Foster[19] noted a greater incidence of spacing in the anterior region of the maxilla compared to other areas of the mouth. Their observations coupled with the anthropological data of Schultz[20] suggests involvement of the premaxilla in variable maxillary anterior arch size and spacing. Future research on the etiology of the maxillary midline diastema should focus on the possible role of variable premaxillary size.

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Author Address

S.M. Hashim Nainar
Department of Pediatric Dentistry
University of Connecticut Health Center
School of Dental Medicine
Farmington, CT 06032

S.M. Hashim Nainar was a House-surgeon in Madras Dental College at the time of the study. He is presently a graduate student in the Department of Pediatric Dentistry, University of Connecticut School of Dental Medicine.

N. Gnanasundaram is Professor and Head of the Department of Oral Medicine, Diagnosis and Dental Radiology at Madras Dental College, ParkTown, Madras, India.

References

1. Keene, H.J.: Distribution of diastemas in the dentition of man. Am. J. Phys. Anthropol., 21:437-441, 1963.
2. Lavelle, C.L.B.: The distribution of diastemas in different human population samples. Scand. J. Dent. Res., 78:530-534, 1970.
3. Steigman, S. and Weissberg, Y.: Spaced dentition: an epidemiologic study. Angle Orthod., 55:167-176, 1985.
4. Angle, E.H.: Treatment of malocclusion of the teeth. Seventh edition. S.S. White Dental Manufacturing Company, Philadelphia, pp 103-104, 1907.
5. McCoy, J.D.: Applied Orthodontia. Second edition. Lea and Febiger, Philadelphia, pp 72, 96-97, 1946.
6. Stones, H.H.: Oral and Dental diseases. Second edition. E. & S. Livingstone Ltd., Edinburgh, pp 19-21, 211, 1951.
7. Sicher, H.: Oral anatomy. Second edition. The C.V. Mosby Company, St. Louis, pp 185, 272-273, 1952.
8. Tait, C.H.: The median frenum of the upper lip and its influence on the spacing of the upper central incisor teeth. Dent. Cosmos., 76:991-992, 1934.
9. Dewel, B.F.: The normal and the abnormal labial frenum: clinical differentiation. J. Am. Dent. Assn., 33:318-329, 1946.
10. Ceremello, P.J.: The superior labial frenum and the midline diastema and their relation to growth and development of the oral structures. Am. J. Orthod., 39:120-139, 1953.
11. Chapman, H.: Separation of the permanent upper centrals. Trans. Brit. Soc. Orthodont., pp 249-257, 1935.
12. Bedell, W.R.: Non-surgical reduction of the labial frenum with and without orthodontic treatment. J. Am. Dent. Assn., 42:510-515, 1951.
13. Baum, A.T.: The midline diastema. J. Oral Med., 21:30-39, 1966.
14. Jacobson, A.: Spacing of the teeth and mid-diastemata in the South African Bantu (Abstract). J. Dent. Res., 47:949, 1968.
15. Gibbs, S.L.: The superior labial frenum and its orthodontic considerations. NY State Dent. J., 34:550-553, 1968.
16. Higley, L.B.: Maxillary labial frenum and midline diastema. J. Dent. Child., 36:413-414, 1969.
17. Bishara, S.E.: Management of diastemas in orthodontics. Am. J. Orthod., 61:55-63, 1972.
18. Popovich, F., Thompson, G.W. and Main, P.A.: The maxillary inter-incisal diastema and its relationship to the superior labial frenum and intermaxillary suture. Angle Orthod., 47:265-271, 1977.
19. Lavelle, C.L.B. and Foster, T.D.: Crowding and spacing of the teeth in an adult British population. Dent. Practit., 19: 239-242, 1969.
20. Schultz, A.H.: The relation in size between premaxilla, diastema and canine. Am. J. Phys. Anthropol., 6:163-179, 1948.