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Characteristics and Stability of Spaced Dentition

A serial study of changes in spacing between teeth during the period of facial maturation, finding tendencies toward closure of buccal spaces and opening of anterior spaces. Spacing in females is equally distributed between upper and lower arches; in males it is more prevalent in the upper arch.

KEY WORDS: • DIASTEMA • SPACED DENTITION •

Spaced dentition, with one or more interproximal spaces in an otherwise normal dental arch, is often viewed as a kind of malocclusion which ought to be treated by orthodontic means. In an epidemiologic survey (STEIGMAN AND WEISSBERG 1985), we discovered this condition in 50% of a study population comprised of 1,279 adolescents 12-18 years of age.

The high frequency of spacing in persons with no other skeletal or dental anomalies suggests that spaced dentition is, in fact, a variation of normal occlusion (SKOLNICK, 1962). This suggests further that treatment of this condition should be based primarily on esthetic considerations.

In view of its high prevalence, the paucity of knowledge regarding spaced dentition is quite amazing. In the previous epidemiologic study, we considered the number, location and size of the spaces, and the relation of spacing to age and sex. The current longitudinal study supplements that cross-sectional investigation in the following three aspects:

- Stability of spaces during the period of occlusal maturation
- Relationship between spaced dentition, tooth size, and dental arch size
- Patterns of occlusal relationship in spaced dentitions.

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— Material and Methods —

Four years subsequent to the earlier epidemiologic study (STEIGMAN AND WEISSBERG 1985), an attempt was made to locate and re-examine all subjects in whom spaced dentition had been registered. Ninety-one persons were traced, twenty of whom had to be excluded because of loss of teeth or orthodontic treatment. Table 1 shows the distribution of the final sample according to age and sex.

Data Collection

All subjects were examined by the same investigator. As in the epidemiologic study, the presence or absence of spacing was recorded using the method of VAN BEEK (1977). All other measurements were carried out on white stone dental study casts made from alginate impressions.

The maximal mesiodistal width of each tooth except the second and third molars was measured with sliding calipers held perpendicular to the long axis of the tooth (MOORREES 1959). Arch width and depth were measured on photostatic copies of the study casts (SINGH AND SAVARA 1964). Arch width was recorded between the first molars, the two bicuspid pairs and the cuspids in each dental arch. Arch depth was measured in the sagittal plane, from the midpoint between the central incisors to the medial tangent line of the first molars (KOYOUMDJISKY-KAYE ET AL. 1976).

Occlusal relations were examined on study casts which recorded the position in final closure. Overbite and overjet were measured in millimeters. The relation between upper and lower cuspids, bicuspids and first molars was graded as follows:

Neutroclusion — contact between the inclined planes of the upper tooth and the two opposing lower teeth

Distoclusion — contact between the upper tooth and the most anterior of the two opposing lower teeth

Mesioclusion — contact between the upper tooth and only the most posterior of the two opposing lower teeth.

Data Evaluation

The mean (±S.D.) number of spacings per subject and the median values were calculated according to sex, age group and location in the maxillary or mandibular arch. The differences between the various groups were analyzed using the Mann-Whitney test at the significance level of $p<0.05$.

Complete closure or persisting spaces were recorded according to sex and age. The condition of each single proximal contact or space was compared to that

Table 1

Age and Sex of Spaced Dentition Sample

Age	Males	Females	Total
16–18	12(16.9%)	16(22.5%)	28(39.4%)
18–20	13(18.3%)	13(18.3%)	26(36.6%)
20–22	8(11.3%)	9(12.7%)	17(24.0%)
Total	33(46.5%)	38(53.5%)	71(100%)

which had existed four years ago, and graded as follows:

Persisting space
Closure of space
New space

The gradings for proximal site were expressed as a percentage of those recorded in the total sample, and the differences between the various sites were analyzed by means of the Z test.

An *index of stability*, the number of present spacings divided by the sum of present and past spacings, was calculated for each proximal site for both sexes.

The sizes of the teeth and of the dental arches were compared to similar data obtained from Israeli populations in previous studies (Koyoumdjisky-Kaye et al. 1976, 1978, Steigman et al. 1982). The Student t test at the significance level of $p<0.05$ was applied to evaluate the differences. The maximum measurement error obtained through double determination on 12 casts two months later was 0.05mm for both tooth and arch measurements.

— Findings —

The mean number of spaces per person did not differ significantly between the sexes (4.85 ± 2.96 in males and 5.17 ± 4.02 in females), and the median values of 4.00 were identical.

The mean number of spaces per person diminished with age. In males, it decreased from 5.40 at ages 16-20 to 3.57 at 20-22. In females, this age-related decrease occurred earlier, with the mean value at 6.64 before 18 years and 4.73 above 18. These age-related changes were statistically significant at $p>0.01$.

The distribution of spacings between the two dental arches varied significantly between the sexes. In males, the mean number of spaces in the maxilla (4.09 ± 1.78) was almost twice that in the mandible (2.67 ± 1.87). In the females the spaces were almost equally divided, with mean values 3.38 ± 2.65 in the maxilla and 3.05pm2.15 in the mandible.

All previously-existing spaces between the teeth had closed and arch continuity established in 21% of the entire sample (Table 2). In the males, this closure occurred predominantly between age 16 and 20, and in the females between 16 and 18.

The grading of spaces and their distribution according to location are presented in Fig. 1. The majority of spaces in both arches were located between cuspid and first bicuspid, which was also the site of most frequent closure. New spaces appeared primarily at the mesial aspects

Table 2

Incidence of Space Closure
in Previously-spaced Dentitions

	Males		Females	
Age	Not Closed	Closed	Not Closed	Closed
16–18	9(75.0%)	3(25.0%)	11(68.8%)	5(31.2%)
18–20	10(76.9%)	3(23.1%)	11(84.6%)	2(15.4%)
20–22	7(87.5%)	1(12.5%)	8(88.9%)	1(11.1%)
Total	26(78.8%)	7(21.2%)	30(78.9%)	8(21.1%)

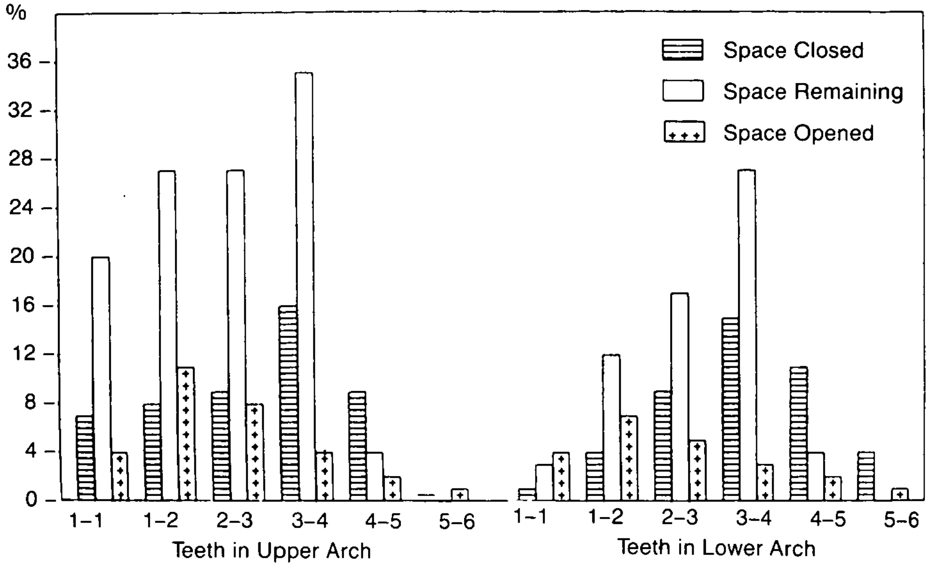

Fig. 1 Distribution and stability of spaces during a four-year period, according to their location. The histograms depict the obliterated, remaining, and new spaces at each interproximal location as a percentage of the total sample.

of the upper and lower lateral incisors. Space stability mesial to the first bicuspid was greater than at the distal (Table 3).

Significant sex dimorphism was found for the mesiodistal width of all teeth.

Tooth size in males was generally comparable to data obtained in other investigations on mixed spaced and closed samples (Koyoumdjisky-Kaye et al. 1976, 1978 and Steigman et al. 1982), with even larger dimensions for the upper and lower lateral incisors and lower cuspids.

In the females, on the other hand, the findings differed distinctly; all teeth except the lateral incisor were significantly narrower than reported in the other studies (Table 4).

Sex dimorphism was also clearly expressed in arch width and arch depth. Comparison of these dimensions with those found by Koyoumdjisky-Kaye et al. (1976 and 1978) did not reveal any significant differences between the samples, except for significantly ($p < 0.05$) wider intercuspid and interbicuspid upper arch widths in the male spaced-dentition sample (Table 5).

The mean values for overjet (2.61±14mm in males and 2.47±1mm in females), and overbite (2.63±1.22mm in males and 2.68±1.56mm in females) were well within normal range. Although the occlusion of all patients was basically Class I, about one third of the upper first molars and half of the upper bicuspids and cuspids occluded with only one antagonist tooth. This created an impression of a Class II or Class III tendency (Table 6).

— Discussion —

This longitudinal study discloses that 79% of the antecedent spaced dentitions in young adolescents had remained through the period of occlusal maturation.

Based on the incidence of spacing in the 12–18 year age group (48.6%), and on the assumption that new spaces do not appear in normal adult closed arches, the frequency of spaced dentition in young adults may be calculated at 38.3%. This percentage agrees with the 32.9% found by LAVELLE (1962) and supports HEMLEY'S (1971) claim that about one third of the adult population presents a spaced dentition as a variation of the normal occlusal pattern.

The distribution of spaces between the various teeth proved to be unstable, at least during the period of occlusal maturation. Some of the spaces closed, while new ones opened up, indicating mesial or distal tooth migration. While spaces distal to the cuspid tended to close, new spaces usually appeared mesially to this tooth. This may be attributable to the eruption of third molars (BISHARA AND ANDREASEN 1983) , the tendency for molars to drift mesially, and the tendency for bicuspids and cuspids to drift distally (NG 1971 AND PICTON 1976).

The most stable space was the maxillary midline diastema, signalling the low probability for spontaneous closure of this particular gap when it persists after full eruption of the cuspids.

In correlating spacing of the dentition with tooth and arch size, definite differences between the sexes became apparent. Mean tooth widths in the male sample did not differ from those of the non-spaced cases, and sometimes even exceeded them. In the females with spaced dentition, the central incisors, cuspids and all posterior teeth were significantly narrower. This suggests a possible additional cause for spaced dentition in females.

The size of female dental arches did not appear to contribute to the origin of spaced dentition, as it was similar in all groups under comparison. In the males, on the other hand, the greater upper intercuspid and interbicuspid width was the only factor which could be related to tooth-arch length discrepancy. These findings are in keeping with the fact that in females the spaces appeared in equal frequency in the mandible and the max-

Table 3

Index of space stability

Space location	Upper Arch		Lower Arch	
	Males	Females	Males	Females
1–1	0.60	0.67	0.67	0.00
1–2	0.57	0.60	0.45	0.57
2–3	0.62	0.62	0.53	0.55
3–4	0.62	0.65	0.52	0.67
4–5	0.00	0.29	0.20	0.29
5–6	0.00	0.00	0.00	0.00

illa, while in males they appeared predominantly in the maxillary arch.

Hemley (1971) described spaced occlusion as one in which occluding teeth opposite the spaces prevent space closure. If such is the case, these teeth would serve as plunger cusps, exerting a possibly detrimental effect on the periodontium in the opposite arch. However, the present study finds that opposing teeth occluded with one antagonist only in more than half of the spaced dentitions.

If we accept spaced dentition as a normal variation, this different mode of anteroposterior relationship of opposing teeth must then logically be considered as a normal, individually well-suited pattern of occlusion.

Table 4

Mean Mesiodistal Width of Teeth
Compared with Other Samples

	MALES			FEMALES		
Tooth	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
			Upper Arch			
1	8.64±0.13	8.56±0.04	–	8.11±0.09	8.43±0.04	–
2	6.89±0.12	6.57±0.04	–	6.36±0.08	6.41±0.04	–
3	7.83±0.09	7.68±0.06	7.86±0.04	7.24±0.05	7.39±0.04	7.67±0.04
4	6.88±0.08	6.93±0.04	7.00±0.03	6.59±0.07	6.71±0.04	6.77±0.03
5	6.65±0.11	6.63±0.04	6.76±0.03	6.25±0.06	6.46±0.04	6.53±0.03
6	10.22±0.11	10.42±0.05	–	9.92±0.09	10.22±0.04	–
			Lower Arch			
1	5.43±0.07	5.32±0.03	–	5.12±0.06	5.26±0.03	–
2	6.03±0.09	5.83±0.03	–	5.64±0.06	5.74±0.03	–
3	6.96±0.08	6.71±0.04	6.81±0.04	6.29±0.05	6.35±0.03	6.51±0.04
4	7.02±0.12	6.97±0.04	7.12±0.04	6.62±0.07	6.74±0.05	6.93±0.04
5	7.14±0.13	7.15±0.05	7.12±0.04	6.74±0.07	6.99±0.05	6.93±0.04
6	10.87±0.13	10.96±0.05	–	10.36±0.09	10.65±0.04	–

Sample 1 — Present Study Sample
Sample 2 — Koyoumdjisky-Kaye et al. 1976, 1978
Weighted mean, four Jewish ethnic groups,
spaced and non-spaced dentitions
Sample 3 — Steigman et al. 1982
Mixed Jewish ethnic origin, non-spaced dentitions

$p < .05$
$p < .01$
$p < .001$

— Summary —

Young adults, all with detailed recordings of spaced dentition in otherwise normal occlusions of four years standing, were re-examined to identify any changes that had occurred during occlusal maturation.

All spaces had been obliterated in 21% of these subjects. This shortening of the dental arches was especially apparent in females before the age of 18 years and in males up to 20 years. In the remaining cases, a reshuffling of space locations was manifest. Many previously-existing spaces had disappeared, especially in the posterior parts of the arches. New spaces had opened, mostly in the anterior segment of the arch.

Spacing in females occurred with the same frequency in both dental arches, whereas in males spacing was much more prevalent in the maxillary arch.

Comparison of spaced and closed dentitions revealed that in females the mean mesiodistal tooth widths were significantly narrower in spaced dentitions,

Table 5

Arch Width and Depth
Compared with Another Sample

	MALES		FEMALES	
	Sample 1	Sample 2	Sample 1	Sample 2
		Upper Arch		
Arch Width				
3–3	35.29±0.46	34.17±0.23	32.31±0.27	32.66±0.16
4–4	32.67±0.47	31.69±0.22	30.31±0.37	30.42±0.15
5–5	37.13±0.47	37.06±0.27	35.30±0.42	35.27±0.19
6–6	41.34±0.61	41.45±0.18	39.85±0.43	39.90±0.19
Arch depth	28.51±0.42	28.78±0.15	27.00±0.37	27.78±0.37
		Lower Arch		
Arch Width				
3–3	26.73±0.47	26.52±0.15	24.97±0.30	25.53±0.13
4–4	28.64±0.50	28.84±0.18	27.55±0.30	27.95±0.15
5–5	31.87±0.58	32.57±0.27	31.42±0.42	31.78±0.21
6–6	34.75±0.57	35.49±0.18	34.07±0.46	34.55±0.15
Arch depth	23.54±0.54	24.23±0.14	22.95±0.31	23.17±0.15

Sample 1 — Present Study Sample
Sample 2 — Koyoumdjisky-Kaye et al. 1976, 1978
Spaced and non-spaced dentitions

p<.05

Table 6

Distribution of Posterior Occlusal Contacts in Spaced Dentition
(Percent)

Teeth in Contact	Number	Neutroclusion	Distoclusion	Mesioclusion
$\frac{3}{3-4}$	103	57.3%	40.8%	1.9%
$\frac{4}{4-5}$	101	61.4%	32.7%	5.9%
$\frac{5}{5-6}$	95	57.9%	36.8%	5.3%
$\frac{6}{6-7}$	98	73.5%	15.3%	11.2%

while spaced maxillary arches in males had significantly greater intercuspid and interbicuspid widths. This indicates two different causes of the spaced dentitions.

The occlusion of the incisors, as expressed in overbite and overjet, was within normal range. However, the antero-posterior occlusal relationship between cuspids, bicuspids and molars included some distoclusion or mesioclusion of the various pairs of antagonistic teeth in about half of this sample population.

A/O

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