Occlusal Traits in a Group of School Children in an Isolated Society in Jerusalem

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Abstract: *The prevalence of occlusal features in 939 children, aged 6–13 years, belonging to an ultra-orthodox community of Jewish Ashkenazi descent living in Jerusalem was studied clinically. Sexual dimorphism was found for overjet, overbite, and habit practising. About one-quarter of the sample exhibited some degree of occlusal mutilation due to caries, thus creating a 'caries-affected' subgroup, the rest forming the 'caries-free' subgroup. In the latter set, normocclusion was scarce (7·4 per cent), Class I being the most frequent malocclusion (49·1 per cent). Caries had a significant effect on the symmetry of bilateral occlusal relationships, lower dental midline deviation, and on crowding/spacing conditions in the mixed dentition stage (except for the maxilla in late mixed dentition). The low prevalence of normocclusion can be attributed to genetic background, environmental influences and the definition attached to normal occlusion.*

Index words: Isolated Society, Occlusal Traits, School Children.

Introduction

Analysis of the prevalence of occlusal features in a random young population may widen the scope of our knowledge regarding the development of occlusion. Ethnic variability has given rise to abundant studies on occlusal development in various parts of the world (Goose *et al.*, 1957; Helm, 1968; Horowitz, 1970; El-Mangoury and Mostafa, 1990). Israel, by virtue of its being a country of immigration, has a heterogeneous population composed of many ethnic groups. Previous investigations have shown characteristic occlusal traits in isolated ethnic Jewish groups (Krzypow *et al.*, 1974; Koyoumdjisky-Kay and Steigman, 1982). A study encompassing a multi-ethnic Jewish population in Jerusalem addressed the distribution of malocclusion, as well as the various disaggregated measures of occlusion (Shano, 1986). The changing patterns of dental caries in the youth of a Jerusalem neighbourhood (Rafalovitz *et al.*, 1994) and effect of caries on occlusal traits have been described (Brin *et al.*, 1996). The present sample consists of one such ethnic group, namely Jewish youngsters of ultra-orthodox Ashkenazi origin, aged between 6 and 13 years, in whom occlusal features were examined.

Ashkenazi Jews (Encyclopaedia Britannica, 1975) comprise one of the largest ethnic groups in Israel, containing some ultra-orthodox factions. For many centuries, these particular religious communities have conducted a distinct lifestyle, expressed, among others, in a separate education system and endogamy. The children who form the subject of this study belong to one such religious faction.

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Methods and Materials

Subjects and Setting

Ashkenazi children attending three non-co-educational schools of the ultra-orthodox education system located in the Jerusalem district were screened during the 1992/93 school year for need of orthodontic treatment as part of a consultation service provided by the Faculty of Dental Medicine of the Hebrew University. In a pilot study, the pupils of one class (34 children) were examined so as to co-ordinate between the examiners and to test the suitability of a specially designed data form, after which the items were adapted according to the needs of the research. After having served its purpose, the data obtained in that preparatory study were discarded, and the children were excluded from the investigation.

All pupils present in their classroom at the time of screening were entered into the survey, except for 30 children who were currently undergoing or had undergone in the past, orthodontic treatment. However, in 17 of them, the pretreatment status and study models were obtained from their orthodontists.

Although the use of these sources of information might have introduced methodological bias to some extent, the exclusion of this data would have undermined the validity of the distribution of the malocclusion to an even greater degree. The children whose study models could not be traced (n = 13), absentees (n = 48), the few who refused to participate (n = 2), and one child with Down's syndrome were excluded. Children with deciduous dentition were not included in the study because of the small size of that group (n = 15). The final number of children enroled in the study was 939, aged 6–13 years (Table 1).

We were guided by a number of definitions of dental developmental stages.

Early mixed dentition: from eruption of the first permanent

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TABLE 1 *Distribution of the study sample*

Gender	Dental developmental stage			
	Early mixed	Late mixed	Permanent	Total
Girls	231	171	40	442
Boys	335	122	40	497
Total	566	293	80	939

tooth until eruption of the first succedeneous buccal tooth (canine or premolar). If early extraction of a deciduous molar was suspected, but could not be confirmed anamnestically, the developmental stage was determined according to the presence/absence of lower deciduous canines (that is, lower deciduous canines *in situ* placed the child in the early mixed dentition category).

Late mixed dentition: from eruption of the first succedeneous buccal tooth (canine or premolar) until the shedding of the last deciduous tooth.

Permanent dentition: after shedding of the last deciduous tooth.

The examinations were conducted on the school premises (nurse's office) using daylight illumination. Each child was seen by two senior orthodontists: one of them (I. B.) participated in all sessions, while the other two examiners (Y.B. and D.H.) attended interchangeably.

The parameters and criteria used in this study are outlined below.

I. Antero-posterior Dimension

1. Angle's classification: normal occlusion (including cases with caries, provided the occlusal relationships were unaffected by the decay), Class I, II/1, II/2, II subdivision, and Class III malocclusions.
2. Molar relationship: plane (P) or step (S) termination (in the mixed dentitions), or Angle's class I, II, or III.
3. Canine relationships: Class I, II, or III, according to Angle. In both molar and canine relationships, half unit Class II or half unit Class III were considered Class II or Class III, respectively.
   In the mutilated dentition, canine and molar relationships were recorded as observed and no attempt was made to pursue the original intercuspation.
4. Overjet: evaluated to the nearest 0·5 mm; normal range was determined at 0·5–4·0 mm.
5. Anterior cross-bite: included were teeth in an edge-to-edge position.

II. Transverse Dimension

1. Upper midline: evaluated in relation to facial midline.
2. Lower midline deviation in relation to facial midline; to differentiate between midline deviations of skeletal/functional and dental origin, a possible cause for the latter (i.e. premature extraction) was looked for; no attempt was made to differentiate between lower skeletal and functional shift because of low reliability of the clinical examination for this parameter when performed under the given conditions; deviations were recorded to the nearest 0·5 mm.
3. Posterior cross-bite: buccal/palatal; included were teeth in an edge-to-edge position.

III. Vertical Dimension

1. Overbite, as evaluated to the nearest 0·5 mm, including complete/incomplete overbite and open bites; normal range was determined at 0·5–3·5 mm, very deep overbite $\geq$ 6.5 mm.
2. Submerged teeth: occlusal surface of a deciduous molar at least 1 mm cervical to the occlusal plane of fully erupted neighboring teeth (Kurol, 1981).

IV. Other

1. Crowding/spacing: evaluated per arch in each jaw, according to (a) no crowding/no spacing (including crowding $\leq$ 0·5 mm and spacing 0·5 mm), (b) crowding ($>$ 0·5 mm), and (c) spacing ($>$ 0·5 mm).
2. Habits: each child was asked about any oral habits. It should be noted that within the clinical setting, relative privacy was maintained by keeping a distance between the child in the chair and its mates waiting to be examined.
3. Caries: carious lesions were recorded by visual inspection only. For the purpose of this work, dentitions were divided into two categories: (a) 'caries-affected', encompassing premature extraction or interproximal carious lesions causing loss of arch length, and (b) 'caries-free', comprising non-carious dentition or dentition with caries not influencing arch length (e.g. occlusal caries).

Statistical Analysis

All statistical evaluations were performed for both the total sample and subgroups, utilizing the chi-square test.

Results

The results of the evaluation of sexual dimorphism are presented in Figs 1 and 2. Because this component proved statistically significant for overjet (P = 0·01), overbite (P = 0·001) and habits (p = 0·001), these parameters were evaluated separately.

The discrimination between 'caries-affected' and 'caries-free' placed 234 children (about one-quarter of the total sample) in the former subgroup; 705 children comprised the 'caries-free' subgroup. Comparison between these two subgroups for the distribution of the relevant parameters is presented in Tables 2, 3, and 4. It should be noted, however, that owing to incomplete information in some cases, the total will not always add up to 939.

Occlusal Relationships in the Antero-posterior Dimension

Asymmetrical canine and molar relationships were significantly more prevalent in the 'caries-affected' subgroup

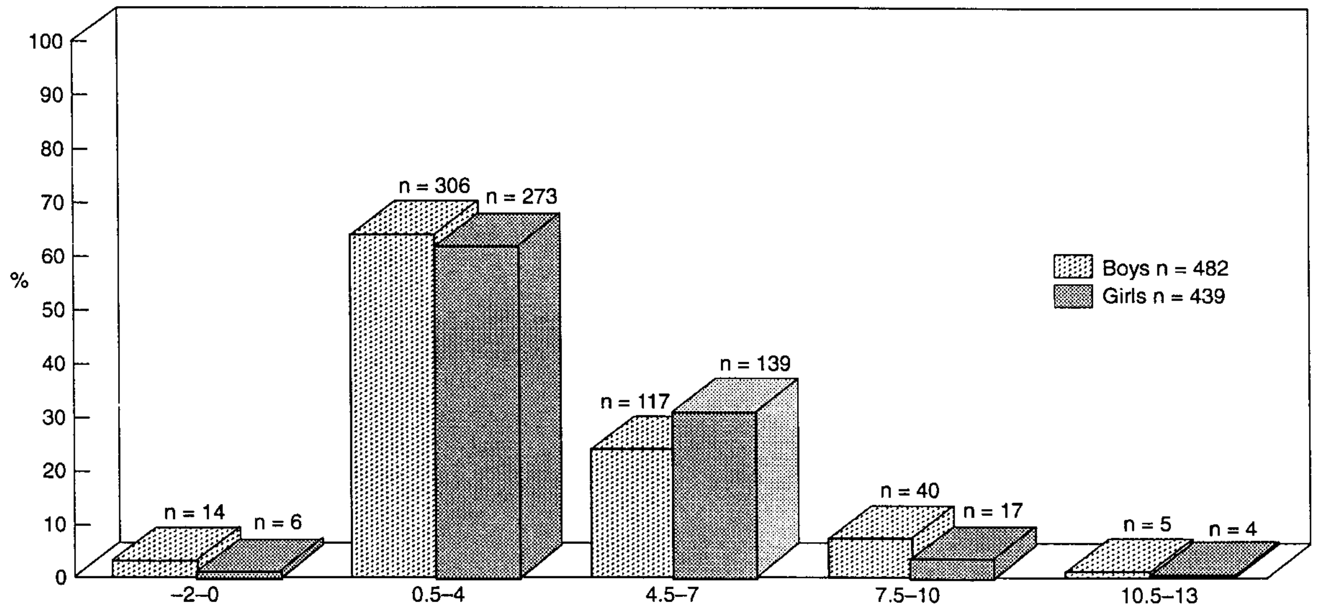

FIG. 1 Distribution of overjet values (in mm) according to gender ($P = 0{\cdot}01$).

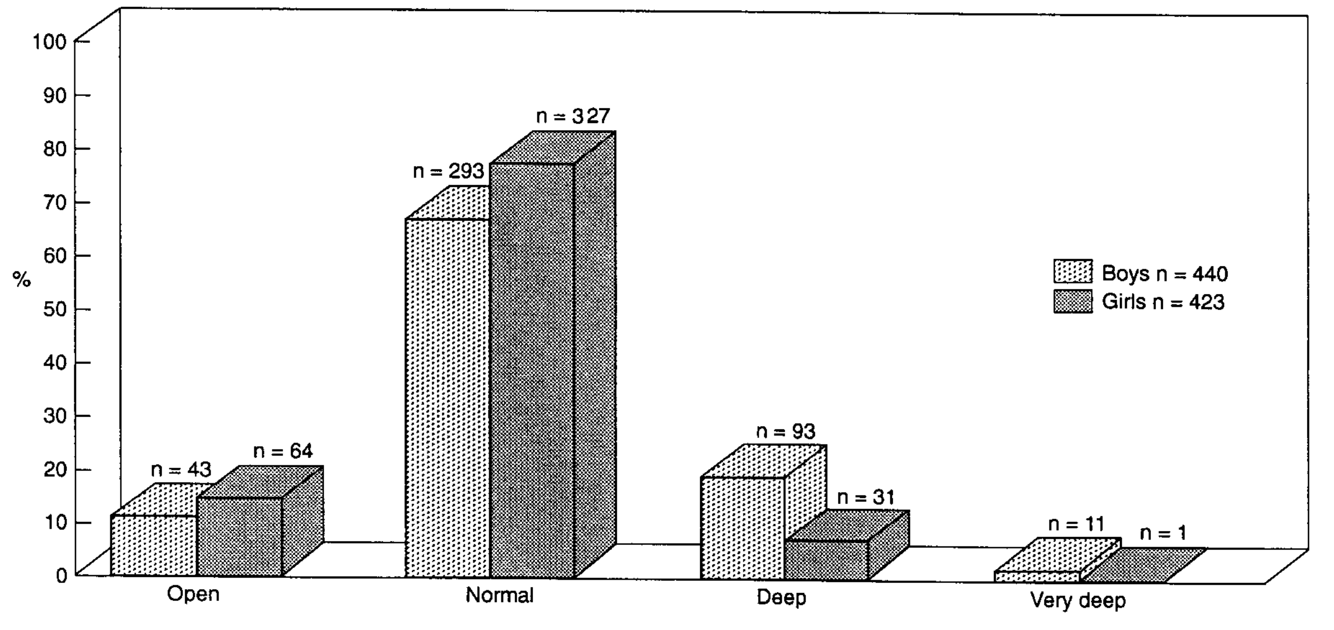

FIG. 2 Distribution of overbite categories according to gender ($P = 0{\cdot}001$).

(Table 2). As the presence of caries may affect Angle's classification of occlusal relationship, the distribution of normal occlusion and the various categories of malocclusion is presented for the 'caries-free' subgroup only (Table 5).

Normal overjet (0·5–4·0 mm) predominated among the examined children, with boys carrying a slightly higher percentage (Fig. 1). The prevalence of anterior cross-bite is found in Table 2.

Occlusal Relationships in the Transverse Dimension

The distribution of midline shifts and posterior cross-bite is presented in Table 2. The frequency of midline deviation was higher in the 'caries-affected' subgroup, especially in the lower dental category ($P = 0{\cdot}001$).

Buccal cross-bite was found in 1·5 per cent of the total sample.

Occlusal Relationships in the Vertical Dimension

Normal overbite was displayed by more than 70 per cent of the children examined (Fig. 2). No significant differences were found in the distribution of the various categories of overbite between the 'caries-free' and 'caries-affected' subgroups. However, comparison between the sexes revealed a significantly deeper overbite in the male

TABLE 2 *Comparison of the distribution of the relevant parameters*

Parameter	'Caries-free'			'Caries-affected'			*P* value
	Total*	*N***	%	Total*	*N***	%	
Molar relationship	705			231			
Symmetrical		501	71·1		129	55·8	0·001
Asymmetrical		204	28·9		102	44·2	0·001
Canine relationship	691			223			
Symmetrical		538	77·9		150	67·3	0·001
Asymmetrical		153	22·1		73	32·7	0·001
Enlarged overjet ♀	333	127	38·1	106	33	31·1	NS
(>4 mm) ♂	357	119	33·3	125	43	34·4	NS
Enlarged overbite ♀	323	23	7·1	100	9	9·0	NS
(>3.5 mm) ♂	322	68	21·1	118	36	30·5	NS
Upper dental midline deviation	705	67	9·5	234	30	12·8	NS
Lower midline deviation	703	231	32·9	234	95	40·6	0·05
Dental	703	89	12·7	234	80	34·2	0·001
Skeletal/functional	703	142	20·2	234	15	6·4	0·001
Anterior cross-bite	702	65	9·3	234	24	10·3	NS
Posterior cross-bite	705	128	16·2	234	36	15·4	NS

* Number of recordable individuals.
** Number of positive findings.

TABLE 3 *Comparison between the 'caries-free'* (n = *703) and 'caries-affected'* (n = *234) sub-groups for maxillary crowding/spacing condition*

Parameter	'Caries-free'		'Caries-affected'		*P* value
	N	%	*N*	%	
Early mixed dentition	411	100	155	100	
No crowding/no spacing	125	30·4	44	28·4	NS
Crowding*	145	35·3	87	56·1	0·0001
Spacing**	141	34·3	24	15·5	0·001
Late mixed dentition	219	100	73	100	
No crowding/no spacing	80	36·5	26	35·6	NS
Crowding*	88	40·2	32	43·8	NS
Spacing**	51	23·3	15	20·6	NS
Permanent dentition	73	100	6	100	
No crowding/no spacing	23	31·5	2	33·3	†
Crowding*	35	47·9	4	66·6	†
Spacing**	15	20·6	0		

* > 0·5 mm; ** > 0·5 mm
† Statistical comparison could not be done because of the small size of the sample in the 'caries-affected' subgroup.

children (P = 0·001; Fig. 2). With regard to dental submergence, 13·3 per cent of children in the total sample had at least one submerged tooth. When divided into chronological age groups, this feature was highest in the 8·5–10-year old age bracket (15·5 per cent).

Crowding/Spacing (Tables 3 and 4)

Crowding prevailed in both jaws, differing significantly (P = 0·001) between the 'caries-free' and 'caries affected' subgroups in the mixed dentition stages, except for the maxilla in the late mixed dentition. In the permanent dentition, the small size of the 'caries affected' subgroup prohibited statistical comparison.

Habits

Clinical evidence as to oral habit practising, supported by affirmative answers to questioning, was found in 11·8 per cent of the total sample, which divided according to gender, accounted for 79/442 (17·9 per cent) girls and 37/497 (7·4 per cent) boys (P = 0·001).

Discussion

The orthodontic literature is replete with reports dealing with the prevalence of occlusal types as found in various populations (Goose *et al.*, 1957; Helm, 1968, 1970; Horowitz, 1970; Kelly *et al.*, 1973; Salzman, 1977; Koyoumdjisky-Kaye and Steigman, 1982; McLain *et al.*, 1983; Siriwat and Jarabak, 1985; Rozier *et al.*, 1988; McLain

TABLE 4 *Comparison between the 'caries-free' (n = 705) and 'caries-affected' (n = 234) sub-groups for mandibular crowding/spacing condition*

Parameter	'Caries-free'		'Caries-affected'		*P* value
	N	%	*N*	%	
Early mixed dentition	412	100	155	100	
No crowding/no spacing	139	33·7	35	22·6	NS
Crowding*	186	45·2	107	69·0	0·001
Spacing**	87	21·1	13	8·4	0·001
Late mixed dentition	219	100	73	100	
No crowding/no spacing	104	47·5	23	31·5	NS
Crowding*	85	38·8	46	63·0	0·001
Spacing**	30	13·7	4	5·5	0·058
Permanent dentition	74	100	6	100	
No crowding/no spacing	33	44·6	1	16·7	†
Crowding*	33	44·6	5	83·3	†
Spacing**	8	10·8	0	0	

* > 0·5 mm; ** > 0·5 mm

† Statistical comparison could not be done because of the small size of the sample in the 'caries-affected' subgroup.

TABLE 5 *Distribution of the various occlusal categories according to Angle in the 'caries-free' (n = 703) subgroup*

Occlusal category	*N*	%
Normal	52	7·4
Class I	345	49·1
Class II/1	225	32·0
Class II/2	16	2·3
Class II subdivision	60	8·5
Class III	5	0·7

and Proffit, 1989; El-Mangoury and Mostafa, 1990). The distribution of dental traits is affected by ethnic origin as well as by environmental conditions. In this respect, the subjects of the present study are of special interest because they belong to a closed society with a homogeneous ethnic background, which for hundreds of years has pursued a singular lifestyle.

Sexual Dimorphism

Consistent with previous observations that occlusal traits exhibit sexual dimorphism (Helm, 1968; Moyers *et al.*, 1976; Rozier *et al.*, 1988), significant differences existed with respect to three parameters. Habit practicing was preponderant in girls, a phenomenon also noted by others (Kelly *et al.*, 1973). This gender differences may arise from the attitude by parents and teachers toward the practice of, for example, thumb sucking in that they make a distinction between the sexes. Habit practising might also have had a bearing on the other two dental parameters which showed significant sex differences. Thus, large overjet occurred more frequently in the girls, while deep overbite was a more typical feature in the boys. It should be kept in mind, however, that despite the precautions taken in this study, one must take into account the inherent weakness of interviewing on sensitive issues.

Occlusal Relationships

1. Normocclusion. Although the definitions of normal occlusion and of the various classes of malocclusion according to Angle present some problems (Katz, 1992), these criteria are still the most widely applied, especially in clinical practice. Using this system, the prevalence of normocclusion discovered in the 'caries-free' subgroup in the present group of youngsters population was strikingly low (7·4 per cent). An equally low rate was found by Horowitz (1970) in American children in the same age range as the discussed group. Goose *et al.* (1957) and Helm (1968), on the other hand, reported frequencies of 56·1 per cent in British children and of 21·5 per cent in Danish children, respectively. The large discrepancies can be attributed to factors such as genetic background and environmental influences (El-Mangoury and Mostafa, 1990), but they are also due to the interpretation of normal occlusion (Smith, 1991). Furthermore, because of the variability in the sequence of eruption and the particular occlusal patterns that emerge after the eruption of each new tooth, especially in mixed dentitions, evaluation of occlusal status at this stage is severely hampered owing to the blurred dental distribution.

2. Malocclusion. Overall, the prevalence of malocclusion classes in this survey of youngsters differs from the figures published by others for populations in comparable age range. Still, as in many other reports (Rosenzweig, 1961; Helm, 1968; Solow and Helm, 1968; Horowitz, 1970; Salzman, 1977; Siriwat and Jarabak, 1985), Class I malocclusion presented with the highest prevalence among the children in this study, its frequency approaching that found by Siriwat and Jarabak (1985). Their rate of occurrence of Class II (46·4 per cent) in a population of exclusively malocclusions practically equals that of the current study (46·2 per cent), provided our material is manipulated according to these authors' study design. The prevalence of Class I in our study, on the other hand, was higher than that reported by these authors. The divergent results may be due partly to ethnic variability and partly to the known overlap between normal occlusion and malocclusion (Moorrees and Gron, 1966), two factors which might have helped shift cases of normocclusion to the Class I malocclusion category. The extremely low prevalence of Class III approached that found by Solow and Helm (1968) in Danish children.

Analysis of the particular occlusal traits (e.g. posterior cross-bite) revealed agreement between the prevalences in our cohort and the series published in the orthodontic literature (Helm, 1970; Kelly *et al.*, 1973; Kürol, 1981; Koyoumdjisky-Kaye and Steigman, 1982; McLain *et al.*, 1983; McLain and Proffit, 1989).

3. Effects of Caries. Interproximal caries and its sequelae are considered potent factors in creating changes in occlusal relationships (Pedersen *et al.*, 1978). One of the effects of interproximal caries may be altered antero-posterior molar relationships. The higher prevalence of bilateral asymmetrical relationships in the 'caries-affected' subgroup was therefore not an unexpected finding. It should be kept in mind, however, that interproximal caries or premature extractions are not the only aetiological factors for asymmetrical dental relationships, since these may also reflect a functional mandibular shift or an underlying skeletal asymmetric condition. A reliable differentiation between functional and skeletal deviations would require diagnostic aids that would be beyond the clinical setting of the present study.

Symmetry prevailed in the canine region. This dichotomy between molar and canine relationships might have been attributable to three factors: (a) mesial drift promoting the change in molar relationship following extraction; (b) the often pronounced cuspid occlusion having a stabilizing effect on intercuspation, an effect that may be absent in the molar region thereby allowing molar migration; (c) teeth extracted (e.g. more second than first deciduous molars, information that was not recorded). Thus, the originally symmetrical canine relationships were more often maintained in spite of premature extraction, while the symmetrical molar relationships were easily disturbed.

The finding that caries or premature extraction failed to influence the frequency of posterior cross-bite and deep overbite is not in keeping with the study of Pedersen *et al.* (1978), who detected a significantly higher prevalence of these traits in their sample. This discrepancy between their and our study might be due to a dissimilar distribution of extraction sites. For example, more extractions of maxillary second deciduous molars in their sample may have resulted in 'rolling in' of the first permanent molar with consequent posterior cross-bite. Another reason for the discrepancy may be that Pedersen *et al.* (1978) refer to extraction cases only, whereas the 'caries-affected' category in the present study comprises extractions as well as carious lesions affecting occlusion. It is suggested that such a combination has an attenuating effect on the prevalence of posterior cross-bite and deep overbite.

Further analysis revealed a differential effect of caries on midline relationship in the upper and lower jaw. The frequency of upper midline deviation was practically identical in the 'caries-affected' and 'caries-free' subgroups, whereas the lower dental midline deviation was more prevalent in the 'caries-affected' subgroup. The rates of lower midline deviation and asymmetrical canine relationships in the 'caries-affected' subgroup barely varied (34·2 and 32·7 per cent, respectively). This phenomenon is in accordance with the findings of Hoffding and Kisling (1978), who maintain that in the upper arch the extraction space tends to close from the rear, thus having little impact on the upper midline. In the lower arch, on the other hand, premature extraction is followed by a more frequent migration of the anterior segment, thereby affecting the dental midline and canine relations.

As already observed by others (Helm, 1968; Rönnerman and Thilander, 1977), crowding/spacing conditions were affected by caries, especially in the mandible. Distribution of crowding in the mixed dentition stage placed a higher percentage of children in the 'caries-affected' subgroup. Statistical evaluation of crowding/spacing in the permanent dentition stage could not be undertaken due to the small number of children in the 'caries-affected' subgroup ($n = 6$).

The most notable finding among the children surveyed was the low prevalence of normal occlusion. This may be a reflection of ethnic variability and the isolated life style of this ultra-orthodox society, which does not allow ethnic admixture with the surrounding population. The resultant 'inbreeding' effect may express itself in a host of behavioural (Seidman *et al.*, 1987; Ever-Hadani *et al.*, 1994) and/or genetically-dependent (Nelkin, 1963; Bonne-Tamir *et al.*, 1979) parameters, in which may be included scant normal occlusion.

In view of the dynamic processes that form in inherent part of the developmental stages studied, the scarcity of normal occlusion might be transitory. Analysis of a large sample of more mature permanent dentition is mandatory in order to obtain a clear and valid picture of the distribution of occlusal patterns in a given population.

Acknowledgements

We acknowledge the help of Mr I. Einot, M.Sc. with the statistical work-up of the data. We also thank the schoolchildren who participated in the study, the school administrators, and classroom teachers who provided access and help during the examinations.

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