

Incisal and occlusal tooth wear in children and adolescents in a Swedish population

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The material consisted of 527 randomly selected children and adolescents from the community of Jönköping, Sweden, who in 1983 reached the age of 3, 5, 10, 15, or 20 years. The degree of incisal or occlusal tooth wear was evaluated for each single tooth in accordance with the following criteria: score 0 = no wear or negligible wear of enamel; score 1 = obvious wear of enamel or wear through the enamel to the dentin in single spots; score 2 = wear of the dentin up to one-third of the crown height; and score 3 = wear of the dentin more than one-third of the crown height. In the age groups 3 and 5 years the primary dentition was studied, and in the age groups 10, 15, and 20 years the permanent dentition. In the 3-year-old children 63% and in the 5-year-olds 19% had no or slight incisal or occlusal wear in the primary dentition. In the permanent dentition the corresponding figures for the 10-, 15-, and 20-year-olds were 78%, 51%, and 35%, respectively. The 5-year-olds had the highest percentage of primary teeth with incisal or occlusal wear related to existing teeth in accordance with criteria 1–3 (32.2%), and the 10-year-olds had the lowest score for permanent teeth (2.5%). There were small or no differences in tooth wear between the sexes in these age groups. Eighteen children (17%) among the 5-year-olds had one or more teeth with wear scored 2 in the primary dentition, and one individual had 4 primary teeth scored 3. The corresponding figures for the 3-, 10-, 15-, and 20 year-olds were 2%, 1%, 7% and 6%, respectively. No permanent teeth with wear scored 3 were found in these age groups. The number of teeth with incisal or occlusal wear increased with age both in the primary and in the permanent dentition. □ *Dental attrition; epidemiology, oral; pedodontics; tooth abrasion*

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Teeth in function exposed to the oral environment will be affected by incisal or occlusal tooth wear. Attrition and abrasion are often used synonymously, but these concepts differ. According to Pindborg (1), *tooth attrition* is defined as gradual and regular loss of tooth substance as a result of natural mastication. *Tooth abrasion* means the pathologic wearing away of dental hard tissue by the friction of a foreign body, independent of occlusion. *Dental erosion* may be defined as superficial loss of dental hard tissue by a chemical process that does not involve bacteria. Thus, tooth wear is related to factors responsible for the changes in tooth substances; for review, see Ekfeldt (2) and Dahl et al. (3).

Incisal and occlusal tooth wear have been studied in several epidemiologic and clinical investigations. Thus, Davies & Pedersen (4) studied tooth wear on primary teeth and on the first permanent molars in primitive and urbanized Greenland natives. They found that the degree of incisal or occlusal wear decreased with increasing urbanization. When comparing incisal or occlusal wear of deciduous teeth in skeletal material of children, Lunt (5) found less severe tooth wear in Scottish medieval children than in a contemporary group of English children.

Nilner & Lassing (6), in a Swedish study, randomly examined selected children 7–14 years of age of all the subjects who showed signs of incisal or occlusal wear on

primary and permanent teeth. The frequencies of parafunction registered were 16% grinding and 20% clenching among those children examined.

In another Swedish study, Egermark-Eriksson (7) showed that dentin was visible on at least one incisor in 14% of 15-year-old adolescents and that incisal and occlusal wear increased with age. In a follow-up study the corresponding figure for the 20-year-olds was 86% (8). Kampe et al. (9) found wear facets with exposed dentin in 93% of the teeth in a group of adolescents aged 17–22 years.

In a study of 510 Belgian children aged 3–6 years, de Vis et al. (10) reported incisal wear in 41% of the front teeth and occlusal wear in 22% of the molars. The prevalence of bruxism reported by the parents was 8%. De Boever & van den Berghe (11) re-examined 75 randomly selected children from this group 5 years later and found that tooth wear increased in the molar region and decreased in the frontal region in the mixed dentition.

Bernal & Tsamtsouris (12) examined 149 3- to 5-year-old children living in England. They found a 21% prevalence of tooth wear and more wear on incisors and canines than on molars.

As most previous studies are based on heterogeneous patient materials, small groups, and poorly defined criteria, we decided to perform the present study and

Table 1. Number of randomized individuals, non-respondents, and subjects examined

Age group (years)	No. of individuals				
	Randomized	Non-respondent	Examined		
			Females	Males	Total
3	130	29	59	42	101
5	130	22	42	66	108
10	130	19	46	65	111
15	130	23	55	52	107
20	130	30	55	45	100
Total	650	123	257	270	527

Table 2. Total number of teeth and the percentage of teeth with incisal or occlusal wear of the total number of teeth in each age group (mean value ($\bar{x}$) and standard deviation (SD)) (3- and 5-year-olds' primary teeth; 10-, 15-, and 20-year-olds' permanent teeth)

Age group (years)	Total no. of teeth		Teeth (%) with wear/individuals							
			Score 1 + 2 + 3		Score 1		Score 2		Score 3	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
3	19.8	1.1	10.7	19.2	10.4	18.3	0.3	2.2	0	0
5	19.3	1.0	32.2	27.6	28.1	24.0	3.9	10.0	0.2	1.9
10	16.5	4.7	2.5	6.0	2.3	5.5	0.1	1.4	0	0
15	27.2	1.5	9.0	13.4	8.3	12.2	0.7	3.1	0	0
20	27.4	1.1	13.6	14.6	13.0	13.8	0.6	2.5	0	0

describe the prevalence and severity of incisal and occlusal tooth wear in defined age groups in a random sample of children and adolescents in a Swedish population, using standardized criteria.

Materials and methods

The material consisted of 527 randomly selected children and adolescents who in the year 1983 reached the age of 3, 5, 10, 15, or 20 years. Originally 130 subjects were randomly selected from each age group. The number of non-respondents, the number of subjects examined, and the sex distribution are presented in Table 1. For details of the sampling procedure and the reason for non-response, see Hugoson et al. (13).

The individuals taking part in the study were examined clinically and radiographically in 1983 with regard to the health of the teeth and jaws. In the age groups 3 and 5 years the primary dentition was studied, and in the age groups 10, 15, and 20 years the permanent dentition. The examinations were carried out under optimal clinical conditions by seven dentists at the Institute for Postgraduate Dental Education in Jönköping. Before the registration procedures, all

examiners were calibrated on the basis of the diagnostic criteria used (14).

Diagnostic criteria

The degree of incisal or occlusal wear was evaluated for each single tooth in accordance with the following criteria: score 0 = no wear or negligible wear of enamel; score 1 = obvious wear of enamel or wear through the enamel to the dentin in single spots; score 2 = wear of the dentin up to one-third of the crown height; and score 3 = wear of the dentin more than one-third of the crown height.

Analysis of the observation errors

To check the examiners' ability to interpret the scoring of incisal or occlusal wear, an interindividual comparison was carried out on a randomly selected sample of 20 subjects. Each subject was scored independently by the examiners.

An analysis of variance (ANOVA) intraclass correlation approach was used for estimation of the agreement between the examiners.

This test of reliability indicated good agreement (JCC for score 0 = 0.985, score 1 = 0.883, and for score 3 = 0.950) between the examiners selected (15).

Table 3. Percentage of teeth with incisal or occlusal wear of the total number of teeth in females and males, scored 1, 2, and 3 in different age groups (mean values ($\bar{x}$), standard deviation (SD), and level of significance of differences between the sexes) (3- and 5-year-olds' primary teeth; 10-, 15-, and 20-year-olds' permanent teeth)

Age group (years)	Sex	Score 1 + 2 + 3			Score 2 + 3		
		$\bar{x}$	SD		$\bar{x}$	SD	
3	Female	9.7	18.2	NS	0.2	1.3	NS
	Male	12.1	20.8		0.5	3.1	
5	Female	33.0	28.9	NS	5.4	13.3	NS
	Male	31.7	26.9		3.3	8.9	
10	Female	2.0	4.9	NS	0	0	NS
	Male	2.9	6.8		0.2	1.8	
15	Female	5.5	9.5	$p < 0.01$	0.2	1.4	NS
	Male	12.8	15.7		1.2	4.2	
20	Female	11.3	13.0	NS	0	0	$p < 0.01$
	Male	16.4	15.9		1.3	3.7	

Data processing and statistical methods

The data were analyzed by an ABC 800 computer (Luxor), and mean values were calculated for incisors, canines, premolars, and molars. Distribution was assessed.

Statistics were compared by a large-sample technique. All statistical tests were two-tailed and at the 5% significance level.

Results

Data on incisal and occlusal wear

Of the 3-year-old children 63% and of the 5-year-olds 19% had no or slight incisal or occlusal wear in the primary dentition.

Among the 10-year-old children 78% had no or slight wear in the permanent dentition. The corresponding figures for the 15- and 20-year-olds were 51% and 35%, respectively.

In Table 2 the mean number of existing teeth and the percentage of teeth with incisal or occlusal wear related to existing teeth are given as mean values for each age group. The lowest score was 2.5% for permanent teeth in 10-year-old children and the highest 32.2% for primary teeth in the 5-year-olds.

In Table 3 the percentage of teeth with wear in females and males is given for each age group. The 15-year-old boys showed more teeth with incisal or occlusal wear of any degree than the girls ($p < 0.01$). A significant difference was also found between the sexes in tooth wear score 2 and 3 in the 20-year-olds.

The distribution of individuals by number of teeth with incisal or occlusal wear of different degrees is given

Table 4. Frequency distribution of subjects in different age groups in accordance with the number of teeth with occlusal wear of different degrees (3- and 5-year-olds' primary teeth; 10-, 15-, and 20-year-olds' permanent teeth)

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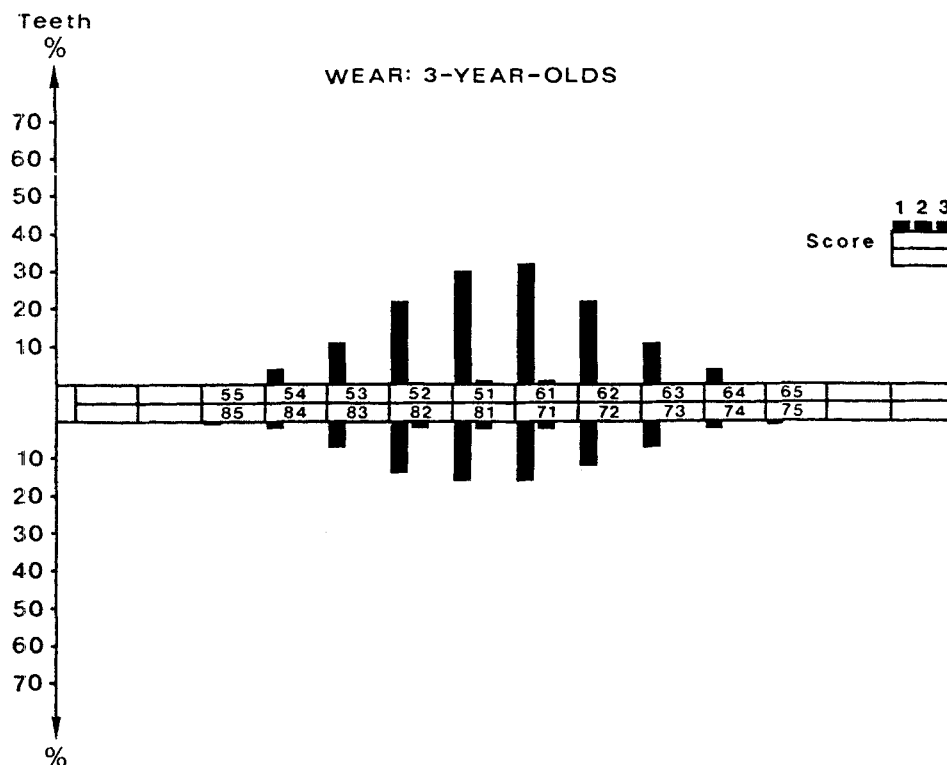


Fig. 1. Frequency (%) distribution of deciduous teeth with incisal or occlusal wear within the dentition of 3-year-old subjects.

in Table 4 for each age group. Eighteen children (17%) among the 5-year-olds had one or more teeth with wear scored 2 in the primary dentition. One 10-year-old child (1%) had four permanent teeth with wear scored 2; the corresponding figures for the individuals aged 15 and 20 years were 7 (7%) and 6 (6%), respectively. No permanent teeth with wear scored 3 were found in these age groups.

Distribution of incisal and occlusal wear within the dentition

The distribution of incisal or occlusal wear within the dentition is shown in Figs. 1 to 5. Mean values for different degrees of incisal or occlusal wear are given for each tooth and for different age groups. In the 3-year-olds 20% to 30% of the upper incisors and approximately 15% of the incisors in the lower jaw showed wear with score 1. Incisal wear with score 2 was rare and found in 1% to 2% of the incisors in the upper or lower jaw.

In the 5-year-olds there were more primary teeth with wear score 1 than in the 3-year-olds. In the upper jaw 40% to 50% of the incisors and 60% of the canines showed wear score 1. The corresponding figures for the lower jaw were 25% and 40%, respectively. Premolars and molars were also affected. Four subjects had 16 teeth or more with wear scored 1. Ten per cent of the front teeth in the upper and 5% in the lower jaw

showed wear with score 2. One individual had four front teeth with incisal wear scored 3.

In the 10-year-olds there were few permanent teeth with incisal wear: approximately 5% of the incisors and canines in the upper and 10% in the lower jaw.

In the 15-year-olds almost 15% of the incisors and canines in the upper and 10% to 30% in the lower jaw showed wear score 1. However, 1 subject had 22 teeth scored as having wear with score 1. There were a few front teeth with wear score 2.

In the 20-year-olds the prevalence of teeth with incisal wear scored 1 in the upper and lower frontal region was higher than in the 15-year-olds. Twenty to 40% of the upper and lower incisors and canines had incisal wear score 1. Incisal wear score 2 was rare and found in 3% of the incisors of the lower jaw.

Discussion

In this cross-sectional study the prevalence of incisal and occlusal wear was studied in 527 randomly selected children and adolescents aged 3 to 20 years. In all epidemiologic studies a certain rate of non-response is inevitable. In the present study the proportion of non-respondents was 14% to 23% of those invited in each of the age groups from 3 to 20 years. There were various reasons for not taking part in the study; see Hugoson et

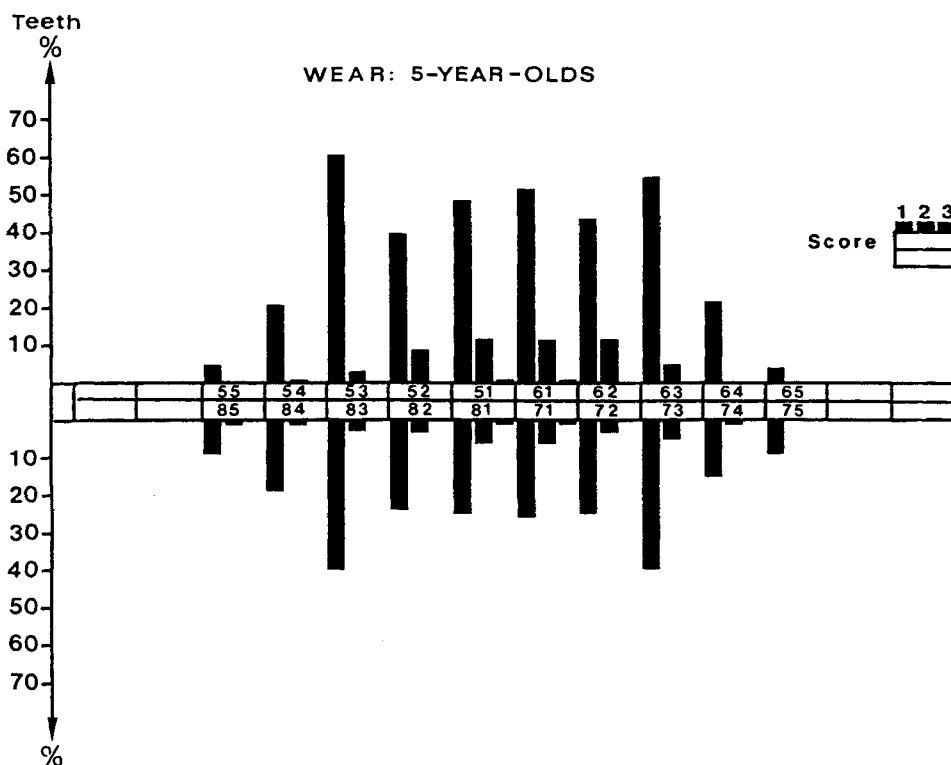


Fig. 2. Frequency (%) distribution of deciduous teeth with incisal or occlusal wear within the dentition of 5-year-old subjects.

al. (13). However, the commonest reasons for non-response were not likely to have any influence on the results.

There is a great need for well-defined and generally accepted criteria for evaluation of tooth wear for use in research and in diagnosing incisal or occlusal wear in individual patients. The index used in this study is based on the same accepted criteria for classification as most of the indices presented, with the intention of quantifying loss of substance by qualitative evaluation of the wear process, often combined with an estimation of the area of exposed dentin or reduction in tooth length (2, 15). The criteria used in this study are simple in outline and, because of difficulties in scoring 'wear of enamel only', single spots of exposed dentin have been scored 1. Other authors have distinguished between the two situations; for a review see Ekfeldt (2). It might be questioned whether such detailed scoring adds anything of clinical significance.

In epidemiologic studies with many subjects examined by several examiners, there is always some interexaminer variability. To restrict the influence of interexaminer variations, well-defined diagnostic criteria should be used, and careful calibration of the examiners should be done. An analysis of the observation error, in the form of a reliability test, was made and showed good interexaminer agreement.

The percentage of individuals showing wear into the dentin was in the present study generally much lower than previously reported by Egermark-Eriksson (7). The percentage of teeth showing wear into the dentin in the study reported by Kampe et al. (9) is far higher than in the present study. A possible explanation of these differences might be that the present study represents a random sample of a normal population, whereas the other studies describe the occlusal wear in selected groups of individuals.

An interesting finding is the high prevalence of incisal and occlusal wear in the primary dentition in the 5-year-olds and the low prevalence in the permanent dentition in the 10-year-olds (Table 2). It is thus obvious that in the mixed dentition tooth wear should be registered separately for primary and permanent teeth. The higher prevalence of incisal or occlusal wear of any degree on the primary teeth observed in the 5-year-olds compared with the 3-year-olds is probably related to the longer exposure time for tooth wear. Ash (16) showed that the enamel was thinner in the primary teeth than in permanent teeth. However, the structure seems to be very similar (17). The findings of Nyström et al. (18) suggested that tooth wear progressed faster in the primary than in the permanent dentition. The incidence of bruxism seems to increase with age through the mixed dentition (19). The higher incidence of bruxism

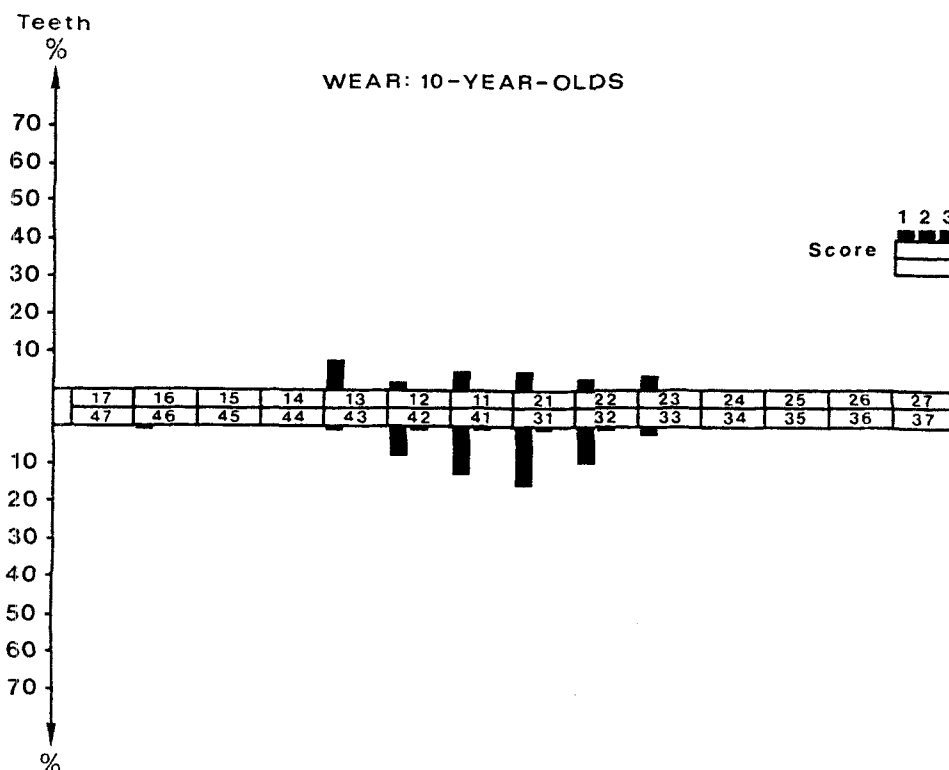


Fig. 3. Frequency (%) distribution of permanent teeth with incisal or occlusal wear within the dentition of 10-year-old subjects.

may reflect a physiologic response to interference in the mixed dentition (20).

In the permanent dentition there was a small increase of incisal wear score 1 with age, mainly affecting the front teeth, in the upper and lower jaw. However, in one 15-year-old individual almost all teeth showed wear score 1. Only a few front teeth had incisal wear score 2, in the permanent dentition, in these age groups.

Contrary to an earlier study in an adult Swedish population (15) and other studies (3, 21), there were small or no differences between the sexes in the total number of teeth with different degrees of tooth wear, except for the 15-year-olds. In this age group boys showed more teeth with incisal or occlusal wear of any degree than girls ($p < 0.01$).

Most of the subjects showed no or only a low degree of incisal or occlusal wear. However, a few individuals with either a large number of teeth with low or moderate wear or some teeth showed extensive wear. The difference in distribution and severity must have a special etiology, depending on several factors, of which bruxism has been most often discussed. The multifactorial character of the tooth wear phenomenon is obvious and is carefully reviewed by Ekfeldt (2) and Dahl et al. (3). In a study of bruxism in children Lindqvist (22) found that 47% of the 12-year-olds in the city of Umeå had wear facets on their teeth. Children with brain damage sometimes showed severe incisal or

occlusal wear (23), which indicates that these children have more pronounced bruxism than normal children. Wear facets in bruxing and non-bruxing children ($n = 358$) from the USA, aged 5–6 years, were examined by Kuch et al. (24). A parental history confirmed by an intraoral examination showed a prevalence of 15% bruxers.

However, a further 15% of the children showed clinical evidence of bruxism without parental awareness of the habit. Occurrence of bruxism is one of the factors found to be correlated to incisal and occlusal tooth wear (2, 3). Extended reviews of the literature on bruxism in children have also been presented by Ahmad (19) and Cash (25).

In a 5-year longitudinal study of adolescents with intact and restored dentitions, frequent parafunctions were reported and more tooth wear observed in the group with restored dentitions (26, 27).

In a comparison of 50 children aged 3–6 years with clinical wear facets with 50 children without any facets, no statistically significant association between primary dentition wear facets and clinical signs of TMD was found (28).

Silness et al. (29) evaluated the longitudinal relationship between incisal wear of central incisors and the magnitude of vertical overbite and horizontal overjet on stone casts in 51 subjects, obtained when the subjects were 15 and 27 years old. They concluded that increase

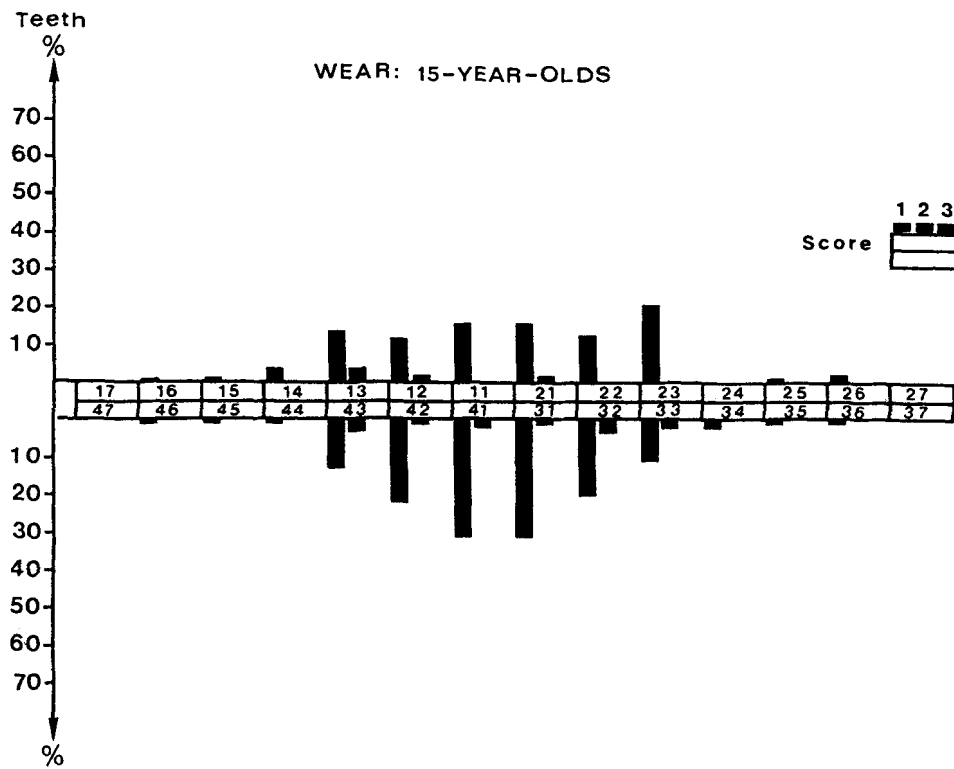


Fig. 4. Frequency (%) distribution of permanent teeth with incisal or occlusal wear within the dentition of 15-year-old subjects.

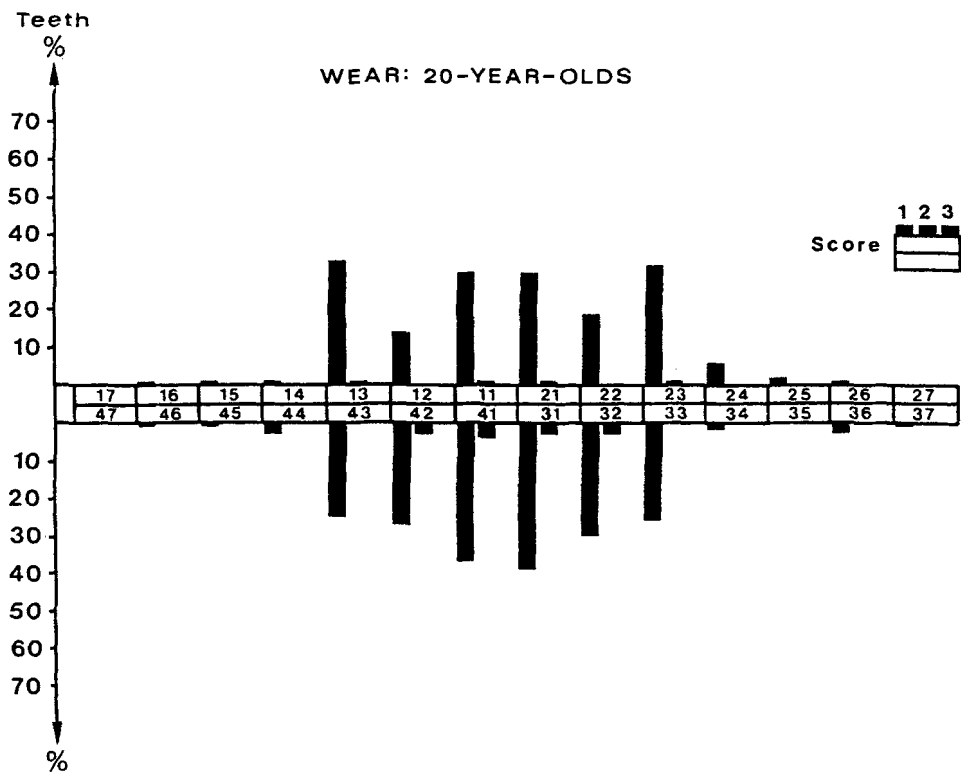


Fig. 5. Frequency (%) distribution of permanent teeth with incisal or occlusal wear within the dentition of 20-year-old subjects.

in age, incisal wear, vertical overbite, and incisal occlusion are clinical predictors of wear of maxillary and mandibular central incisors in adolescents.

In a recent study, Millward et al. (30) found a clear relationship between tooth wear in children and the consumption of fruit-based drinks, especially at bedtime. A diagnosis of tooth wear might thus indicate a need for dietary advice.

An interesting question would be whether excessive wear in the primary dentition can predict wear in the permanent dentition. In a longitudinal study (18) a weak but significant correlation between wear facets of incisors at the age of 5 years and the age of 14 and 18 years was found. On an individual basis, however, wear of primary incisors had a low predictive value for incisal wear in the permanent dentition, according to that study. Further studies are therefore necessary, and the multifactorial etiology of the wear process probably makes it very difficult to predict tooth wear on an individual basis.

However, knowledge of normal physiologic levels of tooth wear in different age groups is interesting and useful in clinical practice. In the present study several individuals aged 10, 15, and 20 years had tooth wear with score 2. It is not known so far whether such early tooth wear indicates a risk situation with increasing age. Follow-up studies of such cases are therefore warranted.

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