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Orthodontic treatment need in French schoolchildren: an epidemiological study using the Index of Orthodontic Treatment Need

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SUMMARY This survey was undertaken to assess the orthodontic treatment need in a sample of 9- to 12-year-old French children (mean age: 9.77 years; standard deviation: 0.84) attending 12 different schools in the same geographic area of Ile de France. Two examiners used the Index of Orthodontic Treatment Need (IOTN) in order to estimate treatment need. Five hundred and eleven children (268 males, 243 females) who had not previously received orthodontic treatment were examined. Two examiners, who had been previously trained in the use of occlusal indices, screened all the schoolchildren. No radiographs, study casts, or previously written records of the children were used; the IOTN was calculated from direct examination.

Qualitative data were analysed using the chi-square test to determine differences in treatment need between subgroups of subjects, and kappa(κ) statistics to analyse the findings. A correlation coefficient was used to compare professional assessments.

Twenty-one per cent of the children presented an objective need for orthodontic treatment, 28 per cent had crowding, 28 per cent an increased overjet, and 15 per cent an increased overbite. The dental health component (DHC) of the IOTN was found to be reliable and simple to use. The malocclusion status of French schoolchildren was lower than that recorded in epidemiological studies of European children.

Introduction

In several French areas, attempts have been made to estimate the proportion of children in need of orthodontic treatment. On the basis of descriptive studies, it has been suggested that 35 to 65 per cent of French schoolchildren between 6 and 12 years of age would benefit from orthodontic treatment (Hescot and Roland, 1993). The World Health Organisation (1985) reported that between 21 and 64 per cent of 13- to 14-year olds had an orthodontic treatment need.

Whereas many indices have been used successfully to record decay, periodontal disease, and temporomandibular joint dysfunction, malocclusion is the only dental anomaly which varies considerably according to the population.

For many years, epidemiological studies of malocclusion suffered from disagreement among investigators about how much deviation from normal should be accepted. Considerable variations exist in the reported prevalence of orthodontic treatment need (Richmond, 2000). These disparities may arise from a lack of objectivity, and poor validity and reliability of the evaluation systems used.

The assessment of malocclusion and treatment need for public health purposes is necessary to plan for orthodontic treatment and training programmes for specialists. Such data are not available for the French population.

Many methods (Draker, 1960; Grainger, 1967; Saltzmann, 1968; Summers, 1971; Linder-Aronson, 1974) designed for assessing malocclusion have been developed. However, a universally accepted index does not exist. The Index of Orthodontic Treatment Need (IOTN; Brook and Shaw, 1989) was developed to rank malocclusion on the basis of the significance of various occlusal traits for dental health and aesthetic impairment. The index incorporates a dental health component (DHC) based on the recommendation of the Swedish Medical Board (Linder-Aronson, 1974) and an aesthetic component (AC) developed by Evans and Shaw (1987). The IOTN has been shown to be valid and reproducible (Shaw *et al.*, 1991). The underlying intention of the IOTN is to identify those individuals who would be most likely to benefit from orthodontic treatment.

The objective of this investigation was to estimate the orthodontic treatment need in a sample of schoolchildren

from the Department of Val d'Oise (a department north-east of Paris, France).

Subjects and methods

Permission to undertake the survey was obtained from the Department of Health and Education. A letter was sent to the parents of the children to seek consent for their co-operation in the study. This letter also served to inform the parents about the examination procedures and to assure them of the confidentiality of any information collected. Only positive consent was accepted. After the examination, the parents received a letter indicating whether orthodontic treatment was necessary. The parents could choose any practitioner for provision of orthodontic treatment.

Twelve schools from seven different geographic administrative divisions situated in the department of Val d'Oise an area of approximately (1250 km^2) were visited during 2000. This department is inhabited by a large majority of average income workers with an unemployment rate that was higher (10.3 per cent) than the average for France (10.1 per cent; Conseil général du Val d'Oise, 2002). It was chosen firstly, for geographic and logistic reasons, and secondly, because there were no health care centres in the vicinity. Moreover, the orthodontic services available were exclusively private.

Children between 9 and 12 years were selected because at this age, they are in the maximum growth period. All 9- to 12-year-old children present on the day of screening (531 subjects) in the 12 schools were examined. Children who had undergone or were undergoing orthodontic treatment were excluded.

Two examiners (MS, NZ), who had been previously trained in the use of the occlusal indices, undertook the screening. The clinical examination was performed using a mobile dental chair with standardized portable lighting. No radiographs, study casts, or previous written records of the children were used. The IOTN was calculated from direct examination, over a period of 2 weeks.

The DHC of IOTN has five grades: grades 1 and 2 represent no/little need for treatment, grade 3 borderline need for treatment, and grades 4 and 5 high priority for treatment. In use, 10 features or traits of malocclusion are considered: overjet, anterior crossbite, overbite, open bite, lateral crossbite, displacement of teeth, impeded eruption of teeth, clefts of lip and/or palate, Class II and Class III buccal occlusion, and hypodontia. The AC is designed to complement the DHC by recording the severity of anterior aesthetic tooth arrangement, with grade 1 being no aesthetic need through grade 10, great aesthetic need for treatment.

Statistical analyses

The data collected were analysed using the Statistical Package for Social Sciences for Windows (SPSS Inc., Chicago, Illinois, USA). Qualitative data were analysed using the chi-square test to determine differences in treatment need between subgroups of participants. The significance level was set at 0.05.

Kappa (κ) statistic (Landis and Koch, 1977), which is a chance-corrected measure of agreement, was used to analyse the findings. A correlation coefficient test was used to compare the professional assessments.

Results

A total of 531, 9- to 12-year-old children (mean age 9.76 years, standard deviation: 0.84; Table 1) participated in the study. Thirteen (2.4 per cent) of the children were undergoing orthodontic treatment and seven (1.3 per cent), whose measurements were recorded, were excluded as teeth had already been moved during the first phase of orthodontic treatment. Of the 511 subjects, 268 were males (52.4 per cent) and 243 females (47.6 per cent).

Table 2 shows the age distribution of the subjects according to the DHC and AC. There was no statistically significant difference in IOTN DHC ($\chi^2 = 14.05$; $P > 0.05$) but a statistically significant difference with the IOTN AC grade ($\chi^2 = 42.05$; $P < 0.05$).

Using the DHC, 50.1 per cent of the children were assigned to the no/little need, 28.6 per cent to borderline need and 21.3 per cent to a need for orthodontic treatment (Table 3). There was no statistical difference between genders according to IOTN DHC grade ($\chi^2 = 3.97$; $P > 0.05$).

Orthodontic treatment need according to aesthetic impairment is shown in Table 4. In 75 per cent of the children, the treatment need was either slight or not indicated according to the AC. Over 18 per cent had a borderline need, while 7 per cent were considered to have a definite treatment need. The 72 children assessed by the AC-DHC examiner as needing treatment also appeared in the DHC need for treatment. For the 109 children with a DHC need for treatment; the majority (75 per cent) were scored using the AC as borderline and 18 per cent as no/little need. There was no statistical gender difference in the IOTN AC grade ($\chi^2 = 6.72$; $P > 0.05$).

The occlusal features found in the children considered to be in need of treatment using the DHC (Table 5) were in order of decreasing frequency: crowding, an overjet 6-mm or greater, posterior crossbites, and increased overbites.

Table 1 Age and gender distribution of the sample.

Gender	*n*	%	Mean age (SD)
Male	268	52.4	9.76 (0.83)
Female	243	47.6	9.76 (0.84)
Total	511	100.0	9.76 (0.84)

SD, standard deviation.

Table 2 The distribution of the aesthetic (AC) and dental health (DHC) components of the Index of Orthodontic Treatment Need (IOTN) between 9 and 12 years of age.

	9 years		10 years		11 years		12 years	
	n	%	*n*	%	*n*	%	*n*	%
IOTN AC								
(1–4)	150	76	171	76	42	79	20	57
(5–7)	31	16	41	18	9	17	11	31
(8–10)	17	8	13	6	2	4	4	12
							($\chi^2 = 14.0$	$P > 0.05$)
IOTN DHC								
(1–2)	92	46	114	51	30	57	20	57
(3)	62	31	63	28	13	25	7	20
(4–5)	44	23	48	21	9	18	8	23
							($\chi^2 = 42.6$	$P < 0.05$)

Table 3 Frequency of the dental health component of the Index of Orthodontic Treatment Need by gender.

Category	Grade	Females		Males		Total	
		n	%	*n*	%	*n*	%
No/little	(1–2)	130	48.5	126	51.9	256	50.1
Borderline	(3)	79	29.5	67	27.6	146	28.6
Great need	(4–5)	59	22	50	20.5	109	21.3
Total		268	100	243	100	511	100

($\chi^2 = 3.97$; $P > 0.05$).

Table 4 Frequency of the aesthetic component of the Index of Orthodontic Treatment Need by gender.

Category	Grade	Females		Males		Total	
		n	%	*n*	%	*n*	%
No/little	(1–4)	202	75.4	181	74.5	383	75
Borderline	(5–7)	46	17.2	46	18.9	92	18
Great need	(8–10)	20	7.4	16	6.6	36	7
Total		268	100	243	100	511	100

($\chi^2 = 6.72$; $P > 0.05$).

Sagittally, an increased overjet was found in 28 per cent of the children, while a mandibular overjet was recorded in only 2 per cent. Vertically, it was found that 15 per cent of the children had an increased overbite (45 per cent with gingival contact and 10 per cent with indentation of the palatal or labial gingivae). None of the children had a lateral open bite. Transversal, unilateral posterior crossbites were recorded for 4 per cent and a bilateral posterior crossbite was found in 4 per cent. Crowding was the most frequent occlusal trait overall (28 per cent).

Cross tabulation between the aesthetic and dental scores based on the examiners' assessments showed that AC and DHC were highly correlated ($r = 0.76$) and the association was highly statistically significant ($P < 0.001$; Table 6).

A κ value of 0.767 for the DHC, representing substantial interexaminer agreement, was obtained. Perfect agreement was achieved for 422 (82.5 per cent) of the children. A κ value of 0.762 was obtained for the AC, again representing substantial agreement. Perfect agreement was achieved for 408 (79.8 per cent) of the children.

Discussion

The present investigation is the first French survey of orthodontic treatment need using the IOTN. Increasing international use of this index allows comparison of orthodontic treatment need in France with other population groups. The recording system was the same as that already

Table 5 Distribution of occlusal traits using the dental health component (DHC) grades of the Index of Orthodontic Treatment Need.

Scoring trait	DHC					Total
	1	2	3	4	5	
Impeded eruption of teeth	0	0	0	0	1	1
Increased overjet	0	14	36	20	2	72
Reversed overjet	0	0	6	5	0	11
Crowding	0	62	56	26	1	145
Open bite	0	3	10	7	0	20
Increased overbite	0	35	35	8	0	78
Unilateral posterior crossbites	0	1	1	20	0	22
Bilateral posterior crossbites	0	0	2	19	0	21
Normal occlusion	141	0	0	0	0	141
Total	141	115	146	105	4	511

Table 6 Interrelationship between examiner-assessed aesthetic component (AC) and dental health component (DHC) grades.

DHC grades	AC grades										Total
	1	2	3	4	5	6	7	8	9	10	
1	100 (19.6)	37 (7.2)	2 (0.4)	1 (0.2)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	141 (27.6)
2	2 (0.4)	49 (9.6)	36 (7.0)	20 (3.9)	7 (1.4)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	151 (22.5)
3	1 (0.2)	21 (4.1)	41 (8.0)	43 (8.4)	7 (1.4)	16 (3.1)	8 (1.6)	8 (1.6)	1 (0.2)	0 (0.0)	146 (28.6)
4	0 (0.0)	4 (0.8)	11 (2.2)	14 (2.7)	8 (1.6)	22 (4.3)	22 (4.3)	16 (3.1)	6 (1.2)	2 (0.4)	105 (20.5)
5	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)	2 (0.4)	4 (0.8)
Total	103 (20.2)	111 (21.7)	90 (17.6)	79 (15.5)	22 (4.3)	40 (7.8)	30 (5.9)	24 (4.7)	8 (1.6)	4 (0.8)	511 (100)

Correlation coefficient $r = 0.76$, $P < 0.001$.

in use in some Scandinavian countries and in the United Kingdom (Brook and Shaw, 1989; Holmes, 1992; Burden, 1995). Current epidemiological data are necessary to detect trends or to determine changes in the prevalence of malocclusion.

The results indicate that 21.3 per cent of schoolchildren had an objective need for orthodontic treatment. This is low compared with British studies where approximately one-third of the population was considered to be in need of orthodontic treatment. In an investigation of 11- to 12-year-old Manchester schoolchildren (Brook and Shaw, 1989), 32.7 per cent were categorized as having a definite orthodontic treatment need. Holmes (1992) reported a prevalence of 32 per cent in a survey of 12-year-old Sheffield schoolchildren and Crowther *et al.* (1997) a similar finding of 31.3 per cent in 10-year-old New Zealand schoolchildren. The proportion of 11- to 12-year olds in need of orthodontic treatment in Northern Ireland was found to be 36 per cent (Burden, 1995). The estimate of one-third of the British population is also comparable with the 29 per cent reported for 12- to 17-year olds in public health survey in the United States (Kelly, 1977) according to the treatment priority index (Grainger, 1967). This is, however, lower than the 53 per cent for 18-year-old Swedish males (Ingervall and Hedegård, 1974).

It is noteworthy that no significant differences in orthodontic treatment need between males and females were observed in the present study.

Despite the mixed dentition composition of the sample, and in agreement with Holmes (1992) and Crowther *et al.* (1997), fewer children were judged using the AC to need treatment than with the DHC. This suggests that AC scale is an unnecessary part of the IOTN when appraising mixed dentitions, possibly because the AC scale depicts only the permanent dentition. Very often, some temporary malocclusion are corrected with age, i.e. the child stops a sucking-habit and dental relationships, under the growth spurt, return to 'normal'. In general, assessment of aesthetic impairment is complex and difficult to measure (Al-Sarheed *et al.*, 2003). Despite this criticism, the AC was highly comparable with the DHC in this study. These findings suggest that, if an aesthetic scale is to be used for appraising mixed dentitions, a more appropriate scale should be developed.

The DHC score is based on a grade assigned to the single 'worst' occlusal trait, which makes it an easy and reliable index to use, but ignores the cumulative effect of a number of lesser occlusal deviations. As a result, it may underestimate the severity of malocclusion in some individuals.

Conclusions

The DHC was found to be reliable, quick, easy to use, and well adapted. However, it is important to see if these results might be applicable to the general population (Cooper *et al.*, 2000). The AC alone failed to identify any children needing orthodontic treatment (Tausche *et al.*, 2004). For all these reasons, the IOTN may be adequate for public health planning and epidemiological purposes. Compared with the dental appearance of Caucasian Americans and other European children, these French schoolchildren were found to have better dental aesthetics and, consequently, a lower (21.3 per cent) orthodontic treatment need.

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