

The value of the aesthetic component of the Index of Orthodontic Treatment Need in the assessment of subjective orthodontic treatment need

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SUMMARY Previous studies carried out using the Index of Orthodontic Treatment Need (IOTN) have reported that the Aesthetic Component (AC) has limited use in schoolchildren. The purpose of this study was to estimate whether dental concern expressed by the grade of the AC chosen by subjects is reliable and whether it may be predictive for potential co-operation. Such a correlation would indicate if the AC of the IOTN may help to identify individuals interested in orthodontic treatment who would co-operate well, and consequently who might derive the greatest benefits.

The investigation was carried out in north-west Poland among 84 schoolchildren (42 girls and 42 boys) aged 12 years and was based on a questionnaire and clinical examination. The questionnaire contained items relating to the subjective assessment of dental appearance, demand for orthodontic treatment, the influence of the dentition on the general appearance, and any functional disorders (speech, mastication, muscular pain, etc.). Clinical examination was carried out at the schools each time by the same dentist. For statistical analysis chi-square (Yates corrected) and McNemar tests were used. A probability at the 5 per cent level or less ($P \leq 0.05$) was considered statistically significant.

The outcome shows that the AC of the IOTN moderately reflects the subjective perception of dental aesthetics and demand for orthodontic treatment. The results indicate that using professional rating the AC scale does not seem to be more precise or reliable than self-evaluation. The correlation between dental concern and the AC would be higher if the 'no treatment need' category was split into two parts (e.g. 1–2 'no need', 3–4 'slight need') or the 'borderline need' category was moved two grades lower. The AC would then help to identify patients interested in treatment who would potentially be co-operative.

Introduction

The deleterious effects of malocclusions on the health of the masticatory system are unclear. Occlusal anomalies are considered to be deviations from the norm rather than a disease (Shaw *et al.*, 1980, 1991a; Hörup *et al.*, 1987; Davies *et al.*, 1988; Rodrigues-Garcia *et al.*, 1998; Nerder *et al.*, 1999). Therefore, the main criterion in the delivery of orthodontic treatment is poor dental aesthetics, as a direct consequence of occlusal irregularities (Brook and Shaw, 1989; Richmond *et al.*, 1995). Aesthetics is a common reason for seeking orthodontic treatment (Dorsey and Korabick, 1977; Shaw *et al.*, 1991b; Tang and So, 1995; Birkeland *et al.*, 1999), and its improvement is an essential treatment goal (Graber and Lucker, 1980; Brook and Shaw, 1989; Birkeland *et al.*, 2000).

Tooth irregularities handicap appearance (Graber and Lucker 1980; Lewis *et al.*, 1982; Shaw *et al.*, 1991b) and as a result social well-being may be compromised (Baldwin, 1980; Shaw *et al.*, 1980; Helm *et al.*, 1985). However, the extent of this handicap is not easily defined (Prah-Andersen *et al.*, 1979; Hörup *et al.*, 1987; Espeland and Stenvik, 1991a; Richmond *et al.*, 1994).

There have been many attempts to develop indices of treatment need, based on a patient's dental appearance (e.g. DAI, Dental Aesthetic Index; Jenny and Cons, 1996), or to modify existing indices by incorporating an Aesthetic Component (e.g. AC of the IOTN, Index of Orthodontic Treatment Need; Brook and Shaw, 1989).

The IOTN was introduced as a combination of the SCAN scale (Standardized Continuum of Aesthetic Need; Evans and Shaw, 1987) and the index used by the Swedish Dental Health Board (Linder-Aronson, 1974). This was subsequently modified by Richmond *et al.* (1992) and later by Lunn *et al.* (1993). The index comprises two parts: the Dental Health Component (DHC), which ranks malocclusions in terms of the significance of tooth irregularities for a person's dental health and the AC, which takes into account the aesthetic impairment. The AC consists of a 10-grade scale illustrated by numbered colour intra-oral photographs. The photographs represent three treatment categories: 'no treatment need' (grades 1–4), 'borderline need' (grades 5–7), and 'great treatment need' (grades 8–10).

The aim of the IOTN is to identify individuals who would be most likely to benefit from treatment (Shaw

et al., 1991a). However, the results of orthodontic therapy depend not only on malocclusion type and intensity, but also on appliance selection and the orthodontist's qualifications and experience (Fox *et al.*, 1997; Bergström *et al.*, 1998; Turbill *et al.*, 1999) as well as patient co-operation (Prahl-Andersen *et al.*, 1979; Shaw *et al.*, 1980, 1986). A patient's readiness to co-operate and motivation should be taken into account during the assessment of treatment need. These factors are not included in the components of the IOTN. Fox *et al.* (2000) created a system for evaluating the importance of anterior tooth aesthetics, based on the AC of the IOTN, for the purpose of predicting patient co-operation and obtaining 'informed consent'. That method, however, seems to be time consuming and complicated to use.

The aim of the present study was to estimate whether dental concern expressed by the grade of the AC chosen by subjects is reliable and may be predictive of potential co-operation. Such a correlation would indicate that the AC of the IOTN may help identify individuals interested in orthodontic treatment who would co-operate well and consequently might derive the greatest benefit. Specifically the aims were: (1) to evaluate the AC grade in relation to the subjective perception of a child's own dental aesthetics; (2) to determine the relationship of the AC grade and demand for orthodontic treatment; and (3) to assess the reliability of the child's evaluation of the AC by comparing it with the professional evaluation.

Subjects and material

The investigation was carried out among 84 children aged 12 years (42 girls and 42 boys) attending the senior classes of two primary schools in north-west Poland. In this group 48 children were currently undergoing or had previously undergone orthodontic treatment. The subjective assessment of the dental appearance and demand for orthodontic treatment was stated on the basis of a questionnaire filled in at school (see Appendix). Additionally, the questionnaires contained items relating to the influence of the dentition on the general appearance and any functional disorders (speech, mastication, muscular pain, etc.).

Methods

The children assessed their own occlusion using a colour illustration of the AC during a clinical examination at school. In order to make the assessment more reliable, a lip retractor and a mirror were employed (Evans and Shaw, 1987; Brook and Shaw 1989). The following question was asked (Lunn *et al.*, 1993): 'Here is a series of 10 photographs showing a range of dental attractiveness, number 1 is the most and number 10 the least attractive arrangement of teeth. Where would you

put your teeth on this scale?' At each examination it was emphasized that a general aesthetic impression was being sought, not an exact match with one of the photographs. At the same time the examiner rated the child's occlusion using the AC scale.

Statistical procedures

A chi-square test (Yates corrected) was applied to evaluate any significant differences between two independent samples (analysis of sex differences, comparison of AC distribution with satisfaction with dental aesthetics and with desire for treatment; Bulman and Osborn, 1989).

The dependent samples were tested with McNemar's test (analysis of any factors that may correlate with the demand for treatment, e.g. a desire to change occlusal features and to start treatment, perception of treatment need, and a desire to start treatment; Jerrold, 1999).

Comparisons of the two aggregated samples were made using the chi-square test (for determining differences between frequencies of yes/no answers, analysing distribution of the AC grades in relation to satisfaction with dental aesthetics and desire for treatment, and testing the consistency of assessment between children and examiner). A probability at the 5 per cent level or less ($P \leq 0.05$) was considered statistically significant.

Results

Tables 1–3 show the answers obtained to the questionnaire and the distribution between the sexes. All the children examined felt that dental aesthetics was an important element of their general appearance (Table 1a). Only one in three subjects reported their dental appearance to be inadequate (Table 1b). Satisfaction with dental aesthetics was expressed by 61.9 per cent (Table 1b). A similar significant percentage (65.4) expressed a wish to change some of the features of their dentition (Table 1c). Among the features mentioned were: arrangement of teeth (55.4%) and colour (43.0%); only one person indicated a desire to change the size of their teeth (1.6%) (Table 1c).

Seven subjects (8.4%) stated that they had functional disorders (Table 2) while 58.3 per cent of children felt they had a need for treatment (Table 3a) and 65.4 per cent wanted to have some treatment (Table 3b). Perceived need and the desire to start treatment showed a sex-related distribution; positive answers came more frequently from girls ($P < 0.05$; they constituted almost two-thirds of subjects who perceived a need for treatment, and almost two-thirds of these who expressed a desire for treatment). None of the remaining responses showed any sex differences ($P > 0.05$).

The results of the assessment of aesthetics using the AC scale of the children and orthodontist are presented

Table 1 Subjective assessment of aesthetics.

a Do you think healthy and well arranged teeth are important for your appearance?	Girls (<i>n</i> = 42)	Boys (<i>n</i> = 42)	Total (<i>n</i> = 84)
Yes	42 (100%)	42 (100%)	84 (100%)
No	–	–	–
Do not know	–	–	–
b Are you satisfied with your dental aesthetics?	Girls (<i>n</i> = 42)	Boys (<i>n</i> = 42)	Total (<i>n</i> = 84)
Yes	28 (66.7%)	24 (57.2%)	52 (61.9%)*
No	12 (28.6%)	14 (33.3%)	26 (30.9%)*
Do not know	2 (4.7%)	4 (9.5%)	6 (7.2%)
c Is there anything you would like to change about your teeth?	Girls (<i>n</i> = 42)	Boys (<i>n</i> = 42)	Total (<i>n</i> = 84)
Yes	29 (69.0%)	26 (61.9%)	55 (65.4%)**
No	12 (28.6%)	12 (28.6%)	24 (28.6%)
Do not know	1 (2.4%)	4 (9.5%)	5 (6.0%)
d What would you like to change?	Girls (<i>n</i> = 34 ^a)	Boys (<i>n</i> = 31 ^a)	Total (<i>n</i> = 65 ^a)
Colour	14 (41.2%)	14 (45.2%)	28 (43.0%)
Arrangement	19 (55.9%)	17 (54.8%)	36 (55.4%)
Size	1 (2.9%)	–	1 (1.6%)

^aThe total number of cases in this part of the table does not correspond to the examined group size, because some individuals gave negative answers, whereas the others highlighted more than one feature. The stated percentages refer to the total number of positive answers.

*Significance level $P < 0.05$; **Significance level $P < 0.01$.

Table 2 Perceived functional disorders.

Do you have any trouble with speaking, chewing, facial muscle pains caused by teeth arrangement?	Girls (<i>n</i> = 42)	Boys (<i>n</i> = 42)	Total (<i>n</i> = 84)
Yes	3 (7.1%)	4 (9.5%)	7 (8.4%)*
No	39 (92.9%)	38 (90.5%)	77 (91.6%)
Do not know	–	–	–

***Significance level $P < 0.001$.

in Table 4. Only five boys (6%) classified themselves in the category 'borderline treatment need' (grades 5–7). The remaining children chose grades 1–4 ('no treatment need'). None of the children placed their own dentition in the category 'great treatment need' (grades 8–10), whereas the examiner placed one person in this category, and 11 children in the category 'borderline treatment need'. Despite these differences the consistency of evaluation in the AC scale according to children and examiner was high considering the category criterion (84.5%; Table 5).

Grade 3 or higher was selected three times more frequently than grade 1 or 2 by children dissatisfied with

dental appearance (Table 6) and twice as frequently by those who expressed a desire for treatment (Table 7).

Discussion

The SCAN scale was created on the basis of intraoral photographs of the dentition of 12-year-old children (Evans and Shaw, 1987). Because of this in the present study, a group of that age was chosen. On the other hand, previous studies carried out using the IOTN have indicated that assigning 'own' dentition to the AC scale is a difficult task, particularly for younger patients (Holmes, 1992).

Table 3 Attitude to orthodontic treatment.

a Do you think you should have orthodontic treatment?	Girls (n = 42)	Boys (n = 42)	Total (n = 84)
Yes	30 (71.4%)*	19 (45.3%)	49 (58.3%)
No	9 (21.4%)*	19 (45.2%)	28 (33.3%)
Do not know	3 (7.2%)	4 (9.5%)	7 (8.4%)

b Would you agree readily to orthodontic treatment if a dentist or parent suggested it?	Girls (n = 42)	Boys (n = 42)	Total (n = 84)
Yes	33 (78.6%)*	22 (52.4%)	55 (65.4%)**
No	7 (16.7%)*	15 (35.7%)	22 (26.3%)
Do not know	2 (4.7%)	5 (11.9%)	7 (8.3%)

*Significance level $P < 0.05$; **Significance level $P < 0.01$.

Table 4 Evaluation of aesthetics in the AC scale of IOTN.

AC grade	Children's evaluation			Orthodontist's evaluation		
	Girls (n = 42)	Boys (n = 42)	Total (n = 84)	Girls (n = 42)	Boys (n = 42)	Total (n = 84)
1–4 (‘no need’)	42 (100.0%)	37 (88.1%)	79** (94.0%)	36 (85.7%)	36 (85.7%)	72 (85.7%)
5–7 (‘borderline need’)	–	5 (11.9%)	5 (6.0%)	5 (11.9%)	6 (14.3%)	11 (13.1%)
8–10 (‘great need’)	–	–	–	1 (2.4%)	–	1 (2.4%)

**Significance level $P < 0.01$.

Table 5 The consistency of the evaluation in the AC scale according to the children and examiner.

Child's evaluation in relation to the examiner opinion	Number of cases ^a (n = 84)	Total
Consistent	35 (41.6%)	71 (84.5%)*
Lower by 1 grade	13 (15.5%)	
Higher by 1 grade	23 (27.4%)	
Lower by 1 category of treatment need	9 (10.7%)	13 (15.5%)
Higher by 1 category of treatment need	3 (3.6%)	
Lower by 2 categories of treatment need	1 (2%)	

^aThe cases where the evaluation of the child and examiner differed by one grade and simultaneously by one category were qualified according to the category criterion.

***Significance level $P < 0.001$.

At this stage of dental development (the late mixed or early permanent dentition), the occlusion exhibits some characteristic traits which are reflected in the AC photographs. These features were found by the examined children in their own dentition. This fact was

Table 6 Satisfaction with dental appearance in relation to the AC grade.

Satisfaction with aesthetics	AC grade (Children's evaluation)				Total (n = 84)
	1	2	3	>3	
Yes	12*	14	13	8	47 (56%)
No	1	7	14	9**	31 (36.9%)
Do not know	–	3	1	2	6 (7.1%)

*Significance level $P < 0.05$; **Significance level $P < 0.01$.

considered to be helpful in assessing aesthetics with superior reliability. Moreover, in order to minimize the risk of comparing morphological deviations in their dentition with the ones presented in the photographs, the examiner emphasized the essence of the construction of the AC, which is the aesthetic aspect. Nevertheless, the decision concerning the AC grade was made more quickly if the child's particular occlusal traits

Table 7 Desire to undertake treatment in relation to AC grade.

Desire to undertake treatment	AC grade (Children's evaluation)				Total (n = 84)
	1	2	3	>3	
Yes	5*	12	23	11	51 (60.7%)
No	9	14	3	3**	29 (34.5%)
Do not know	—	—	1	3	4 (4.8%)

*Significance level $P < 0.05$; **Significance level $P < 0.01$.

were represented on the photograph. An absence of a similarity made assessment difficult for the 12-year-olds. This observation is consistent with the results of previous studies and indicates a tendency to compare tooth morphology (Holmes, 1992; Birkeland *et al.*, 1996). This fact may have had a bearing on the outcome of the assessment of aesthetics by children who were not able to distinguish normal developmental regularities and malocclusions. Espeland and Stenvik (1991a) reported that a more reliable self-evaluation is made by older subjects. However, the age of 12 years is regarded by some authors as an appropriate time to start treatment because of growth potential (Pietilä *et al.*, 1992; Tarvit and Freer, 1998).

Children who had been or were undergoing orthodontic treatment were not excluded from the analysis for several reasons. Firstly, Espeland and Stenvik's (1991a) study showed no significant differences in perception of occlusion in treated and untreated groups, so the results were not influenced. Secondly, treated subjects may still exhibit impaired aesthetics and treatment need. Thirdly, the question relating to desire for treatment in the questionnaire was formulated separately for treated and untreated subjects (treated children were asked to reconsider their decision to undertake treatment or to continue it, if there was such a need). Finally, an examination was performed in a neutral setting (school), so that treated children did not associate it with an orthodontic examination.

The results confirm the view that teenagers attach great importance to an attractive dental appearance (Helm *et al.*, 1985; Espeland and Stanvik, 1991a; Birkeland *et al.*, 1999). Psychological reports (Baldwin, 1980; Shaw *et al.*, 1980) indicate that facial attractiveness is the most important feature for overall appearance (before weight, complexion, etc.), especially the oral region and the eyes. Graber and Lucker (1980) showed that in 55 per cent of people a pleasant dentition was perceived as an important factor in the general facial appearance. This percentage is relatively low compared

with that found in the present study (100%; Table 1a) and may indicate a higher awareness of dental aesthetics than 20 years ago. However, the results did not, as generally supposed, reveal significant sex differences. Some previous studies (Graber and Lucker, 1980; Espeland and Stenvik, 1991b; Birkeland *et al.*, 1996) are in accordance with the present results.

Most of the subjects examined expressed satisfaction with their dental aesthetics (61.9%; Table 1b). Similar results in a group of the same age were obtained by Graber and Lucker (1980). However, this percentage is significantly lower than the percentage of children who classified themselves in the 'no treatment need' category (grades 1–4; Table 4). Satisfied children selected grade 1 or 2 on the AC scale significantly more frequently than dissatisfied individuals (Table 6). Children dissatisfied with their dental appearance selected grade 3 or higher three times more frequently than grade 1 or 2 ($P < 0.05$). It would appear that the separate interpretation of grades 1–2 and 3–4 gives a more realistic perception of dental aesthetics (e.g. 1–2 'no need', 3–4 'slight need'; as was originally established by Brook and Shaw, 1989). The alternative would be to move the category 'borderline need' two grades lower.

A substantial number of the children expressed a desire to change some occlusal features (65.4%; Table 1c). A similarly high percentage of subjects perceived themselves as needing treatment (58.3%; Table 3a), and were willing to undergo orthodontic treatment (65.4%; Table 3b). These figures were higher than those concerning dissatisfaction with dental aesthetics (30.9%; Table 1b), as stated in earlier reports (Birkeland *et al.*, 1996). It is essential to emphasize that 94.0 per cent of the investigated group classified themselves in the category 'no treatment need' according to the AC scale (grades 1–4; Table 4). These results suggest that dental concern expressed using the AC correlates moderately with a demand for treatment. A similar conclusion using the AC was found by Birkeland *et al.* (1996). Again it would appear that the category 'no treatment need' could be divided into two (grades 1–2 and 3–4; Table 7); then subjects who expressed a desire for treatment would choose grades 1–2 (photographs on the attractive end of the scale) significantly less frequently than grades 3–4.

The assessment of treatment need made by children was slightly lower (Table 3a) than the desire to start treatment (Table 3b), and this difference was significant ($P < 0.001$). This suggests a readiness to undergo treatment when an orthodontist states such a need. The most frequent factor reported by the children was the desire to improve aesthetics. Additional factors were: a concern about dental health, and trust in the parents' or orthodontist's decision. As an explanation of negative answers, a general fear of dental treatment was mentioned. An unpleasant experience with orthodontic treatment was highlighted by one person. Of special

significance seems to be the fact that only seven children (8.4%) noticed any functional disorders which were perceived to be connected with malocclusion (Table 2). It confirmed the hypothesis that it is not malfunction of the masticatory system that is the main reason for seeking orthodontic care but aesthetic impairment (Tang and So, 1995; Birkeland *et al.*, 1999).

As reported by Birkeland *et al.* (1996) professional rating using the AC scale does not seem to be more precise than self-evaluation. There was significant agreement between the professional examiner's and the children's assessments, as 84.5 per cent of them were consistent when considering the criterion of treatment category (not the exact grade; Table 5). The children were critical in the assessment of their dental appearance in this study as opposed to investigations by other authors (Evans and Shaw, 1987; Holmes, 1992; Birkeland *et al.*, 1996, 2000). More than one-quarter of the children placed themselves one grade higher in the AC scale than the examining orthodontist (Table 5). The correlation between the grade of the AC ascribed by the orthodontist and child in this study was higher compared with the results of Birkeland *et al.* (1996) and Mandall *et al.* (1999). This was probably due to additional information being given at the time of examination that emphasized the importance of the general aesthetic impression. On the other hand, the distribution of the AC grades scored by the subjects and examiner in the present investigation correlates exactly with the distribution obtained by Fox *et al.* (2000) in a similar group (12-year-olds not seeking orthodontic care), which demonstrated rather realistic perception of occlusion, despite the fact that such instruction was not given in that study.

Conclusions

1. The criteria of the AC scale moderately reflect a subjective perception of dental aesthetics in the 12-year-old group, as 94.0 per cent of the subjects placed themselves in the same treatment category (grades 1–4: 'no treatment need'). However, children dissatisfied with their dental appearance selected grade 3 or higher on the AC scale three times more frequently than satisfied individuals.
2. The AC demonstrates significant correlation with a subjective demand for treatment within the category 'no treatment need', as those who chose grades 1–2 expressed a desire for treatment less frequently than those who chose grade 3 or higher.
3. There was a significant agreement in the AC between the professional rating and the children's assessments, as 84.5 per cent were consistent when considering the category criterion.
4. It would appear that the separate interpretation of grades 1–2 and 3–4 gives more realistic perception of

dental aesthetics and more accurately correlates with demand for treatment (e.g. 1–2 'no need', 3–4 'slight need'). The alternative would be to move the category 'borderline need' two grades lower.

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Appendix (questionnaire)

Name and surname
class date

QUESTIONNAIRE

1. Do you think healthy and well arranged teeth are important for your appearance?

- ☐ Yes
☐ No
☐ Do not know

2. Are you satisfied with your dental aesthetics?

- ☐ Yes
☐ No
☐ Do not know

3. Is there anything you would like to change about your dentition?

- ☐ Yes
☐ No
☐ Do not know.

If this is the case point out what would you like to change:

- ☐ Colour
☐ Size

- ☐ Arrangement
☐ Others (what?)
☐ Nothing

4. Do you have any trouble with speaking, chewing, facial muscle pains caused by teeth arrangement?

- ☐ Yes
☐ No
☐ Do not know

5. Do you think you should have orthodontic treatment?

- ☐ Yes
☐ No
☐ Do not know

6. Would you agree readily to orthodontic treatment if a dentist or parent suggested it? (or would you decide to undergo it again or to continue it, if a dentist stated such a need?)

- ☐ Yes
☐ No
☐ Do not know

Why?
.....
.....

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