European Journal of Orthodontics 24 (2002) 53–59

The Aesthetic Component of the Index of Orthodontic Treatment Need validated against lay opinion

Orlagh Hunt*, Peter Hepper**, Chris Johnston*, Mike Stevenson*** and Donald Burden*

*Division of Orthodontics, **School of Psychology and ***Department of Epidemiology and Public Health, Queen's University Belfast, UK

SUMMARY This study aimed to determine the threshold of aesthetic impairment where orthodontic treatment would be sought by a sample of lay people. Using the 10-grade Aesthetic Component (AC) scale of the Index of Orthodontic Treatment Need (IOTN), 215 university students selected the level of aesthetic impairment that represented the point at which they would seek orthodontic treatment.

Only nine (4.3 per cent) of the respondents recorded a threshold grade beyond grade 5 in the AC. The AC photograph grade 4 was found to be the most commonly selected threshold photograph. Subjects who visited the dentist every 6 months were more likely to choose a threshold photograph closer to the attractive end of the scale than those who visited their dentist less frequently ($P < 0.01$).

This study, using lay people rather than dental health professionals, suggests that as currently used the AC does not reflect society's aesthetic expectations. The results indicate that when using the AC of the IOTN the 'no need for treatment' category should be grades 1–3 of the AC, rather than grades 1–4.

Introduction

It was recognized over three decades ago that any meaningful evaluation of the need for orthodontic treatment must include an assessment of the aesthetic impairment of a malocclusion (Federation Dentaire Internationale, 1970). Others have also concluded that reliable measures of dental aesthetics are essential if the social and psychological implications of malocclusion are to be assessed (Howells and Shaw, 1985). Further indirect support for the use of measures of aesthetic impairment have come from longitudinal studies of the relationship between malocclusion and dental disease (Addy *et al*., 1988; Helm and Peterson, 1989; Shaw *et al*., 1991). These investigations confirmed that, in the main, the ill-effects of malocclusion were psychosocial in nature and related to the aesthetic impairment, rather than any functional disadvantage. It is therefore not surprising that when the Index of Orthodontic Treatment Need (IOTN; Brook and Shaw, 1989) was developed it contained a standardized measure of dental aesthetic impairment, the Aesthetic Component (AC), which is applied entirely independently of the rating of functional disability or occlusal discrepancy (Dental Health Component). The AC consists of a series of 10 colour photographs arranged on a continuum of attractiveness, with grade 1 being the most attractive and grade 10 the least attractive (Figure 1).

During the initial development of IOTN, the subjective opinion of 74 dentists (44 orthodontists and 30 non-orthodontists) was used to validate the cut-off points representing the different levels of orthodontic treatment need. The results of that validation exercise found that according to professional opinion grades 1–4 of the AC represent no need for orthodontic treatment, grades 5–7 represent borderline need, and grades 8–10, definite need for treatment

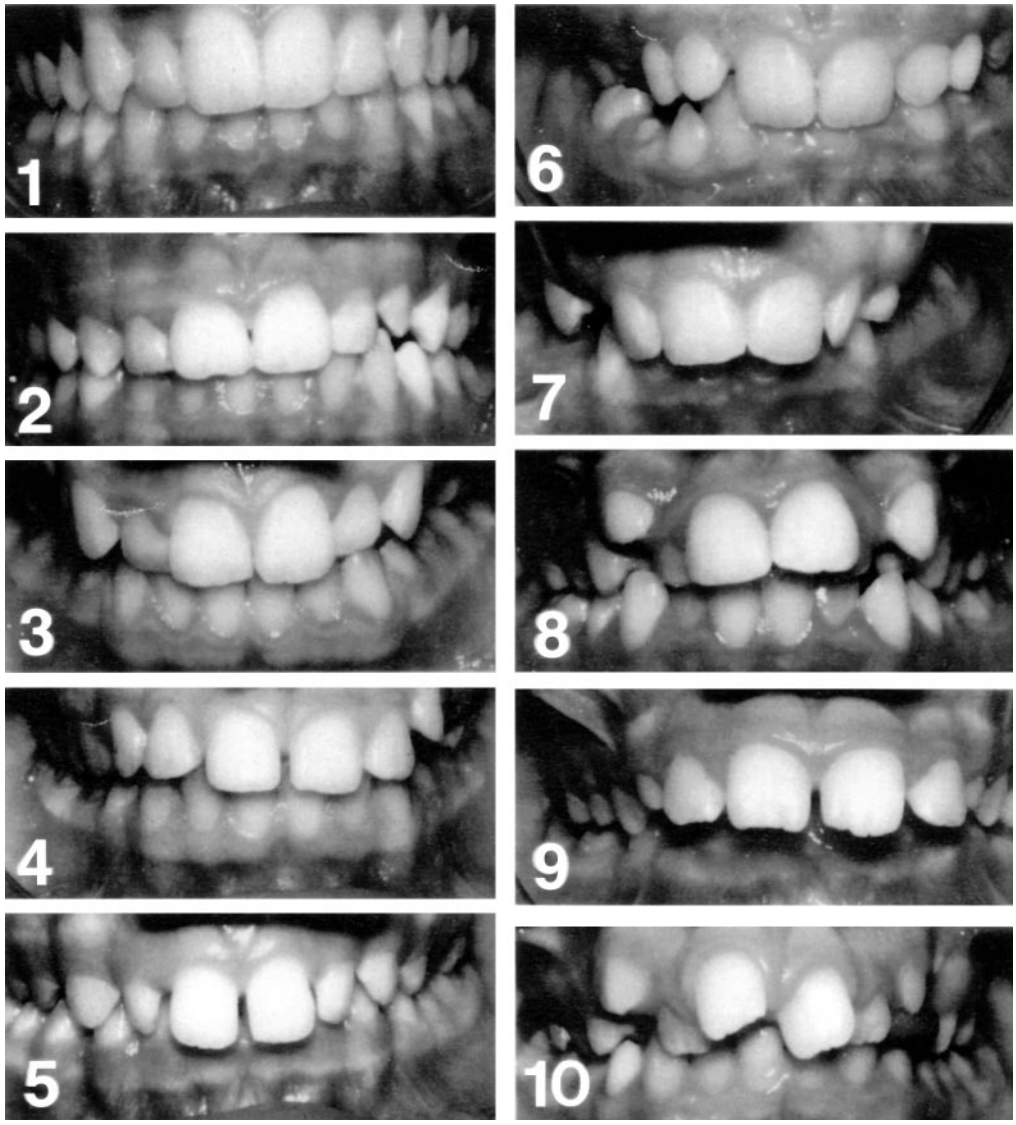

Figure 1 The Aesthetic Component (AC) of the IOTN (Brook and Shaw, 1989).

(Richmond *et al*., 1995). This approach of using the subjective opinion of clinicians to verify treatment need thresholds is not unique and was used by earlier workers to validate other occlusal indices (Salzmann, 1968; Summers, 1971; Jenny *et al*., 1983). Since its introduction by Brook and Shaw (1989) the IOTN has been widely embraced by orthodontists throughout the world (Shaw *et al*., 1995). However, from a scientific perspective, it could be argued that the use of professional opinion to validate an orthodontic aesthetic ranking scale is inherently flawed. Numerous studies have confirmed that, by virtue of their training and experience, dental professionals are conditioned to take an overly critical view of any deviation from normal occlusion (Shaw *et al*., 1975; Prahl-Andersen, 1978). Many dentists favour an interventional

approach even where this is not sought by the patient or parent, and may not necessarily be of significant benefit (Shaw *et al.*, 1975; Prahl-Andersen, 1978; Downer, 1987).

There is, therefore, evidence to support the view that the AC of the IOTN should be validated against the opinion of people who are not dental professionals. The only previous study that has attempted to do this (Stenvik *et al.*, 1997) was compromised by virtue of the fact that the subjects included children who had already been selected for orthodontic treatment.

The present study aimed to determine the threshold at which a sample of lay people would seek orthodontic intervention and to compare this with the threshold level currently suggested by the AC of the IOTN.

Methods

Two hundred and fifteen social science students who were in their first or second year at university were asked to complete a questionnaire to determine the point at which they would wish to receive orthodontic treatment. The subjects comprised 53 males (24.7 per cent) and 162 females (75.3 per cent) with a median age 19 years (range of 17–43 years). The questionnaires were completed during two separate lectures, one consisting of 75 students, the other consisting of 140 students.

A 35-mm colour slide of the AC of the IOTN was projected onto a 15 × 10-m screen in a lecture theatre containing approximately 100 students at any one time. The purpose and use of the AC were explained in a few paragraphs at the beginning of the questionnaire. Participants were instructed to record the AC grade that indicated the point at which they would seek treatment if the photographs represented their own dentition. In addition, the students also rated the attractiveness of their own teeth (very unattractive, unattractive, attractive, or very attractive) and the importance that they attributed to having straight teeth (very unimportant, unimportant, important, or very important).

Each student was asked about their personal experience of orthodontic treatment in terms of whether they had ever been referred for orthodontic treatment, if they felt they should have been referred, whether they had ever received orthodontic treatment, or if they had ever refused orthodontic treatment. In addition, the subjects were asked how frequently they attended the dentist (every 6 months, once a year, every 2 years, less often than every 2 years, only when in pain, never), and if anyone in their immediate family had ever received orthodontic treatment. Subjects were asked not to confer when completing the questionnaires.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS, Version 9, SPSS Inc., Chicago, Illinois). Descriptive statistics were used to describe the subjects' histories in relation to their orthodontic experiences and their dental attendance rates. The relationship between the choice of threshold photograph and the participant variables was analysed using forward stepwise linear regression with the AC rating as the dependent variable. Independent variables entered into the analysis included age, gender, whether or not participants had been referred for orthodontic treatment, if they felt they should have been referred, if they had ever received orthodontic treatment, and if they had ever refused orthodontic treatment. The frequency of dental attendance and whether anyone in their immediate family had ever received orthodontic treatment were also entered into the analysis.

Linear regression analysis was also used to examine the relationship between each subject's opinion of the attractiveness of their own teeth, the importance of having straight teeth, and their choice of threshold photograph in the AC. A χ^2 test was used for tests of association involving categorical data.

Results

Previous experience of orthodontic treatment

The questionnaires returned by four subjects were incomplete for this section and were therefore not included. Ninety-two (43.6 per cent) of the remaining sample reported that they had received orthodontic treatment and 119 (56.4 per cent) reported that they had not.

Among those who did not receive orthodontic treatment, 28 (23.5 per cent) had been offered treatment, but declined and a further 30 subjects (25.2 per cent) felt they should have been referred for treatment. One hundred and twenty subjects (56.8 per cent) reported that a family member had received orthodontic treatment.

Frequency of dental attendance

One hundred and twenty subjects (55.8 per cent) reported that they attended the dentist every 6 months, while a further 49 (22.8 per cent) subjects reported that they visited their dentist once a year. Therefore, the majority of participants (78.6 per cent) attended the dentist at least once a year.

Threshold where orthodontic treatment would be sought

The AC grade 4 was found to be the most commonly selected threshold photograph (Table 1). Ninety-two (42.8 per cent) of the sample selected this grade as the point in the scale of severity at which they would seek orthodontic treatment if the photographs had represented their own dentition. Figure 2 shows the threshold grade selected by the whole sample. By grade 4, 74 per cent of the sample reported that they would seek orthodontic treatment and by grade 5, 95.8 per cent of the sample would seek orthodontic treatment. Only nine (4.3 per cent) of the respondents recorded a threshold grade beyond grade 5 of the AC (Figure 2).

Table 1 The Aesthetic Component (AC) grade where orthodontic treatment would be requested (n = 215).

AC grade	No. of subjects	Percentage of subjects	Cumulative percentage
1	2	0.9	0.9
2	28	13.0	14.0
3	37	17.2	31.2
4	92	42.8	74.0
5	47	21.9	95.8
6	1	0.5	96.3
7	2	0.9	97.2
8	1	0.5	97.7
9	1	0.5	98.1
10	4	1.9	100.0

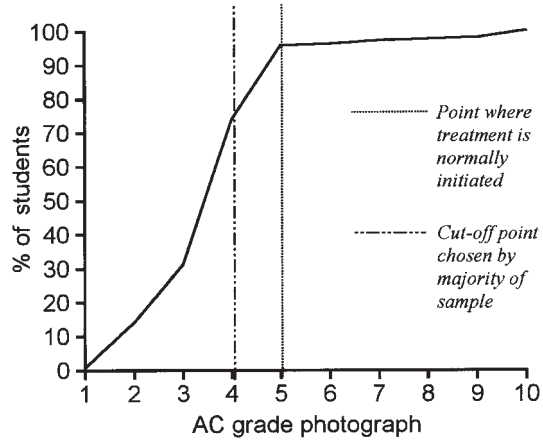

Figure 2 The Aesthetic Component (AC) grade where orthodontic treatment would be requested.

Linear regression analysis was used to explore the relationship between the threshold level selected and each subject's orthodontic experience and dental attendance. The only variable that was found to influence the cut-off point chosen on the AC scale was the frequency of dental attendance. Those who visited their dentist more regularly chose a cut-off grade closer to the more attractive end of the scale compared with those who attended their dentist less frequently ($P < 0.05$).

The relationship between frequency of dental attendance and the selected threshold grade of the AC is illustrated in Table 2. Analysis using the χ^2 test revealed a significant association between those participants who visit the dentist every 6 months and selection of grade 3 or less on the AC ($\chi^2 = 9.88$, $P < 0.01$, df = 1).

Subjects' rating of the attractiveness of own teeth and their opinion on the importance of having straight teeth

The responses to this section of the questionnaire are reported in Table 3. The majority of the subjects (67.9 per cent) considered that their own dentitions were 'attractive' or 'very attractive'. In addition, the majority of respondents

Table 2 The relationship between the frequency of dental attendance and choice of Aesthetic Component (AC) grade.

AC grade	Attends every 6 months		Attends less often than every 6 months	
	n	(cumulative percentage)	*n*	(cumulative percentage)
1	1	(0.8)	1	(1.1)
2	22	(19.2)	6	(7.4)
3	25	(40.0)	12	(20.0)
4	41	(74.2)	51	(73.7)
5	26	(95.8)	21	(95.8)
6+	5	(100)	4	(100)

Table 3 Subjects' perception of the attractiveness of their own teeth and the importance of having straight teeth ($n = 215$).

	No. of participants	Percentage of sample
How attractive do you think your teeth are?		
Very unattractive	5	2.3
Unattractive	61	28.4
Attractive	134	62.3
Very attractive	12	5.6
Missing data	3	1.4
How important is it to have straight teeth?		
Very unimportant	6	2.8
Unimportant	20	9.3
Important	141	65.6
Very important	45	20.9
Missing data	3	1.4

(86.5 per cent) also felt it was 'important' or 'very important' to have straight teeth (Table 3).

Linear regression analysis was conducted to determine whether the participants' opinion of the attractiveness of their own dentition and their perceptions of the importance of having straight teeth influenced their choice of cut-off point for treatment using the AC of the IOTN. No significant relationship was found between participants' ratings of the attractiveness of their own teeth and their choice of threshold photograph on the AC ($P = 0.88$). Although not quite achieving statistical significance, the analysis revealed a trend for those participants who considered having straight teeth as important to choose an AC photograph closer to the attractive end of the scale ($P = 0.07$).

Discussion

This study used the consensus opinion of a large sample of university students to determine the acceptable limit of dental aesthetic impairment. The sample chosen represented a wide range of lay opinion, including those who had had orthodontic treatment and those who had not. Although no evidence exists to suggest that the aesthetic preferences of university students differ from other young adults, this possibility must be considered when interpreting the results of this study.

Previous investigations have found that females tend to express greater concern about their facial appearance than males (Tung and Kiyak, 1998). Whilst the current sample included more females than males, linear regression analysis did not detect any gender influence on the threshold chosen for the initiation of orthodontic treatment.

At the time when this cohort were adolescents, orthodontic treatment was widely available and even if they did not receive orthodontic care themselves, many of their peers did so. A recent survey in Northern Ireland revealed that, among 15- and 16-year-olds, 28 per cent had received orthodontic treatment (Breistein and Burden, 1998). In the current study, 43 per cent of the subjects reported that they had received orthodontic treatment. Even allowing for those who had orthodontic treatment after 16 years of age the sample contained a higher than average level of subjects who had received orthodontic treatment. However, this meant that the sample was almost equally divided between individuals with and without personal experience of orthodontic treatment. The results of this study therefore provide a contemporary view of society's perception of acceptable dental aesthetics among individuals with an up-to-date awareness of the potential benefits of orthodontic treatment. A majority of the subjects (87 per cent) reported that having straight teeth

was important or very important. The age group of the sample (mean = 20.3 years) was also considered to be sufficiently mature to be able to make a balanced judgement on the relative influence of dental aesthetics on social acceptability, self-esteem, and self-confidence. An earlier similar study found that children were significantly less critical in their aesthetic judgements than young adults (Stenvik *et al*., 1997).

It could be argued that dental professionals are best placed to make judgements on the aesthetic values held by potential patients and their families. However, there is evidence that dental professionals' assessment of aesthetic acceptability differs from the layperson (Prahl-Andersen, 1978; Shaw *et al*., 1980). This means that the thresholds adopted in the AC of the IOTN for determining who is and who is not in need of orthodontic treatment may represent the biased view of a small group of dental professionals, rather than the wider view of society.

In this investigation the subjects were asked to decide at what point they would seek orthodontic treatment using the continuum of dental aesthetic impairment represented by the AC. The results indicate that the level of aesthetic impairment represented by grades 6 through to 10 were considered to require orthodontic treatment by 100 per cent of the subjects surveyed. The young adults therefore agree with the professionals' assessment that individuals with this level of aesthetic impairment are in need of orthodontic treatment.

In this type of study, it is always difficult to define the point on a scale of dental attractiveness where orthodontic intervention should be contemplated. However, the results indicate that by the time grade 4 was reached a majority of the participants (74 per cent) had indicated that they would seek orthodontic treatment. A large proportion of the subjects (42 per cent) felt that orthodontic treatment was needed to correct the level of aesthetic impairment represented by grade 4 on the IOTN AC. This result conflicts with the professionally defined threshold currently used by the AC of IOTN (Richmond *et al*., 1995). In normal use, all the grades up to and including grade 4 of the AC are considered to represent little or no need for orthodontic treatment (Richmond *et al*., 1995), yet the majority of this sample of young adults reported that they would seek orthodontic care at a lower level of aesthetic impairment. There is strong evidence from this study to suggest that the threshold point for the initiation of orthodontic treatment should be lowered to grade 3 of the AC, and the 'little or no need' category should only include grades 1–3.

Only one previous investigation has compared the professionally defined cut-off values of the AC with the opinion of lay people. In that Norwegian study, 137 children, 126 of their parents, and 98 young adults were asked to record if any of the 10 dentitions in the AC required orthodontic correction (Stenvik *et al*., 1997). The authors found that in the three groups studied the threshold selected for orthodontic intervention was grade 5 of the AC. They therefore concluded that Norwegian lay people were in agreement with the professionally defined 'no need for treatment' grouping (grades 1–4 of the AC). It is difficult to explain the different findings between this previous study and the present investigation. However, in the Norwegian study the way in which the AC was used was apparently not explained to the subjects and they were not asked specifically to select a threshold image on the continuum.

Nearly one-third (31 per cent) of those questioned in the current study felt that they would seek orthodontic treatment for the level of aesthetic impairment represented by grades 2–3 of the AC. This confirms the high expectations of dental aesthetic perfection among lay people. However, it seems reasonable to define the threshold for the initiation of orthodontic treatment at the point where the majority of lay people would seek treatment, i.e. grade 4. Orthodontic treatment need indices, such as the IOTN, provide the opportunity to reduce subjective bias in determining who is in need of orthodontic treatment and who is not. However, to be scientifically valid occlusal indices must correctly identify those in need. This investigation using lay people rather than dentists suggests that, as currently used, the AC

does not reflect society's aesthetic expectations. To truly reflect lay opinion, a minor adjustment is required to the AC to lower the threshold point for the initiation of treatment by one grade from grade 4 to grade 3.

Using multivariate analysis, the only factor found to influence the choice of threshold for the initiation of orthodontic treatment was the frequency with which the subjects visited their dentist. Those who attended their dentist more frequently (every 6 months) tended to have a lower threshold for the initiation of orthodontic treatment than those who attended less frequently. This most likely reflects the greater emphasis placed on dental health and dental appearance by regular dental attenders.

Conclusions

1. Aesthetic ranking scales used in orthodontic treatment need indices should be validated using lay people who have a good awareness of orthodontic treatment.
2. The results of this study indicate that the threshold for the initiation of orthodontic treatment defined by the AC of the IOTN should be lowered so that grade 4 is included in the treatment need category.
3. This study also found that regular dental attenders had higher expectations of dental aesthetics than those who visited their dentist less frequently.

Address for correspondence

Ms Orlagh Hunt
Division of Orthodontics, School of Dentistry
Queen's University of Belfast
Royal Victoria Hospital
Grosvenor Road
Belfast BT12 6BP
UK

References

Addy M *et al*. 1988 The association between tooth irregularity and plaque accumulation, gingivitis and caries in 11–12 year-old-children. European Journal of Orthodontics 10: 76–83

Breistein B, Burden D J 1998 Equity and orthodontic treatment: a study among adolescents in Northern Ireland. American Journal of Orthodontics and Dentofacial Orthopedics 113: 408–413

Brook P H, Shaw W C 1989 The development of an index of orthodontic treatment priority. European Journal of Orthodontics 11: 309–320

Downer M 1987 Craniofacial anomalies—are they a public health problem? International Dental Journal 37: 193–196

Federation Dentaire Internationale 1970 Epidemiological assessment of dentofacial anomalies. Transactions of the second FDI conference on oral epidemiology. International Dental Journal 20: 563–656

Helm S, Peterson P E 1989 Causal relation between malocclusion and caries. Acta Odontologica Scandinavica 47: 217–221

Howells D J, Shaw W C 1985 The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. American Journal of Orthodontics 88: 402–408

Jenny J, Cons N C, Kohout F J 1983 Comparison of SASOC, a measure of dental aesthetics, with three orthodontic indexes and orthodontist judgement. Community Dentistry and Oral Epidemiology 11: 236–241

Prahl-Andersen B 1978 The need for orthodontic treatment. Angle Orthodontist 48: 1–9

Richmond S, Shaw W C, O'Brien K D, Buchanan I B, Stephens C D, Andrews M, Roberts C T 1995 The relationship between the index of orthodontic treatment need and consensus opinion of a panel of 74 dentists. British Dental Journal 178: 370–374

Salzmann J A 1968 Handicapping malocclusion assessment to establish treatment priority. American Journal of Orthodontics 54: 749–765

Shaw W C, Lewis H G, Robertson N R 1975 Perception of malocclusion. British Dental Journal 138: 211–6

Shaw W C, Addy M, Ray C 1980 Dental and social effects of malocclusion and effectiveness of orthodontic treatment: a review. Community Dentistry and Oral Epidemiology 8: 36–45

Shaw W C, O'Brien K D, Richmond S, Brook P 1991 Quality control in orthodontics: risk/benefit considerations. British Dental Journal 170: 33–37

Shaw W C, Richmond S, O'Brien K D 1995 The use of occlusal indices: a European perspective. American Journal of Orthodontics and Dentofacial Orthopedics 107: 1–10

Stenvik A, Espeland L, Linge B O, Linge L 1997 Lay attitudes to dental appearance and need for orthodontic treatment. European Journal of Orthodontics 19: 271–277

Summers C J 1971 The Occlusal Index: a system for identifying and scoring occlusal disorders. American Journal of Orthodontics 59: 552–567

Tung A W, Kiyak H A 1998 Psychological influences on the timing of orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics 113: 29–39