Ranking dental aesthetics and thresholds of treatment need: a comparison between patients, parents, and dentists

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SUMMARY The aims of the present study were to compare rankings of dental aesthetics and the threshold at which orthodontic treatment would be sought among patients, parents, and dentists. A prospective cross-sectional study was designed to address these aims. The study sample comprised 100 patients and parents and 23 dental specialists. The patients were equally divided between males and females and their mean age was 14.7 years (standard deviation 2.3 years). The aesthetic component (AC) of the Index of Orthodontic Treatment Need (IOTN) represented impairment of dental aesthetics. The 10 numbered photographs of the AC were cut into equal-sized rectangles and subjects were asked to arrange them from 'the one that looks best' to 'the one that looks worst'. The subjects were then presented with the 10 photographs of AC in sequence and asked to identify the cut-off point between 'teeth that need orthodontic treatment' and 'no treatment'. Statistical analysis was undertaken with a Mann–Whitney test.

The results showed that median rankings of dental aesthetics were similar among the three groups (P > 0.05). The median ranking of photographs 1, 2, 3, 4, and 10 were identical to the AC of IOTN. The photographs representing IOTN AC 7 and 8 were allocated the same median rank of 7 and AC 5 and 9 were allocated corresponding median ranks of 6 and 8, respectively. There were no significant differences in median cut-off points for treatment need among the three groups of subjects (P > 0.05), indicating that the mean threshold at which treatment would be sought was AC 4.

Introduction

Demand for orthodontic treatment is mainly motivated by a concern for, and a desire to, improve appearance (Howitt et al., 1967; Shue-Te Yeh et al., 2000; Mandall et al., 2001; Reichmuth et al., 2005). Assessments of dental aesthetics are complex, subjective, and vary greatly between individuals (Kerr and O'Donnell, 1990; Hunt et al., 2002; Hamdan, 2004; Johansson and Follin, 2005). What is an acceptable dental appearance for one person may not be acceptable for another. Objective measures for dental aesthetics have been developed in an attempt to overcome these problems (Howitt et al., 1967; Jenny et al., 1980; Cons et al., 1986; Evans and Shaw, 1987; Brook and Shaw, 1989). Use of such indices allows individuals with the greatest need to be assigned priority when orthodontic resources are limited, and when treatment availability is unevenly spread. Similarly, individuals with little need for treatment can be safeguarded from the potential risks of unnecessary treatment.

The Index of Orthodontic Treatment Need (IOTN) is one of the most widely used occlusal indices in Europe and is gaining widespread use around the world. It is essentially a method of defining the severity or degree of occlusal traits that may constitute a threat to the longevity of the dentition. These traits are then allocated into grades which define the priority of treatment need. The index incorporates both a dental health component (DHC; Brook and Shaw, 1989) and an aesthetic component (AC; Evans and Shaw, 1987). Details of the DHC and representative photographs of the AC are illustrated in the original paper published by Brook and Shaw (1989). The index was also modified to ensure greater reliability especially when used by non-specialists in oral health surveys (Burden *et al.*, 2001).

The validity and reliability of the IOTN have been established by several researchers (Richmond, 1990; Richmond et al., 1995; Younis et al., 1997). Cut-off points for aesthetic need for orthodontic treatment were introduced using professional opinion as the 'gold standard'; grades 1-4 represent 'no need for treatment', grades 5-7 'borderline need', and grades 8-10 'definite need for treatment' (Richmond et al., 1995). Hunt et al. (2002) validated the AC of IOTN against lay opinion and found that the 'no need for treatment' category was represented by grades 1-3 rather than 1-4. Johansson and Follin (2005) asked Swedish orthodontists to evaluate the AC of IOTN and found that grading photographs 2-9 varied greatly but agreement was almost perfect for photographs 1 and 10. A 'definite need for treatment' was assessed for photographs 5 and 7-10, while photograph 6 represented 'borderline need' and 1-4 'no need for treatment'

Occlusal indices define treatment need from a clinician's point of view; however, no consideration is given to concepts of perceptual, functional, and social need. Patients' perceptions of orthodontic treatment cannot be underestimated, as it is the patients who receive treatment and need to gain satisfaction from improved aesthetics and function (Shue-Te Yeh *et al.*, 2000). In addition, desire for orthodontic treatment is primarily influenced by demand and not always by need (Mandall *et al.*, 2001). As a result, simply measuring normative need may not be useful for predicting demand or for manpower planning.

The relationship between normative orthodontic treatment need (clinician measured) and more subjective patient perception of malocclusion has been investigated by several authors (Burden and Pine, 1995; Pietilä and Pietilä, 1996; Mandall *et al.*, 1999; Shue-Te Yeh *et al.*, 2000; Abu Alhaija *et al.*, 2005), yet few studies have considered parents' perceptions of orthodontic treatment need (Espeland *et al.*, 1992; Birkeland *et al.*, 1996; Hamdan, 2004). Ultimately parents make the final decision about treatment, and may have different motives for treatment than their children (Baldwin, 1980). It has also been reported that parents are the most powerful single factor in the motivation for treatment (Lewit and Virolainen, 1968).

The aims of the present study were to compare rankings of dental aesthetics and the threshold at which orthodontic treatment would be sought among patients, parents, and dentists.

The following null hypotheses were proposed:

- 1. There is no difference between patient, parent, and dentists' ranking of dental aesthetics as represented by the AC of IOTN.
- 2. There is no difference between patient, parent, and dentists' cut-off points for orthodontic treatment need as measured by the AC of the IOTN.

Subjects and methods

Ethical approval and consent

Ethical approval was obtained from both the Ethics Committee of Jordan University Hospital and the Faculty of Dentistry at the University of Jordan. A brief outline of the study was explained to all participants and consent was obtained prior to participation.

Sample selection

The study sample comprised 100 consecutive patients attending for orthodontic treatment at the Jordan University Hospital and their parents or guardians. The patients were equally divided between males and females, so that once one group was filled, no others of the same gender were recruited. None of the patients, parents, or guardians invited to participate in the study declined the offer. The sample of dentists included 23 full-time dental specialists at the Dental Department at the Jordan University Hospital. Orthodontic specialists were excluded from the study.

Methods

The AC of the IOTN was used to represent varying degrees of dental aesthetic impairment. The 10 numbered photographs of the AC of IOTN were cut into equal-sized rectangles and the corresponding number of each covered with a sticky label. They were then placed in a paper envelope, in no particular order, and subjects were asked to arrange them from 'the one that looks best' to 'the one that looks worst', by attaching them to a piece of cardboard clearly numbered from 1 to 10 (Figure 1). A strip of Velcro was fixed to the back of each photograph and corresponding Velcro strips were attached to the numbered piece of cardboard (Figure 1). The subjects were then presented with the AC of the IOTN with the 10 photographs in sequence and asked to identify the cut-off point between 'teeth that need orthodontic treatment' and 'no treatment'. Prior to arranging the photographs, the patients and parents were placed in separate rooms and not allowed to confer.

Statistical analyses

A Mann–Whitney test was used to compare data from different groups. Analysis was carried out using the Minitab statistical package (Release 14 Minitab Inc., State College, Pennsylvania, USA) and significance levels were set at 0.05.



Figure 1 An example of the method used for ranking of dental aesthetics.

Results

The patients were aged 11–22 years [mean 14.7 years, standard deviation (SD) 2.3 years], equally divided between males and females. Only five patients (5 per cent) were adults (above 18 years). The mean age of the parents/guardians was 46.9 years (SD 7.5 years) and they were also equally divided by gender. The dentists' mean age was 41.5 years (SD 9.0 years) with only five (22 per cent) being females.

Power calculations indicated that for the present sample size, a difference in ranking of dental aesthetics of one AC grade would be detected with a power of 0.99 ($\alpha = 0.05$) for patient and parent samples and 0.97 ($\alpha = 0.05$) for dentists. A one-grade AC cut-off point difference would be detected with a power of 0.98 ($\alpha = 0.05$) for the current patient and parent samples, and 0.97 ($\alpha = 0.05$) for the sample of dentists.

Ranking of dental aesthetics

Median rankings of dental aesthetics as represented by the AC of IOTN were similar for genders for all 10 photographs. The median ranking of photographs 1, 2, 3, 4, and 10 were identical to the sequence of the AC of the IOTN. The photographs representing IOTN AC 5 and 6 were allocated the same median rank of 6 by both genders. Similarly, IOTN AC 7 and 8 were allocated a median rank of 7. IOTN AC 9 was allocated a median rank of 8 by both males and females. A Mann–Whitney test was used to compare rankings. As no statistically significant differences were found (P > 0.05) the data were pooled for further analysis.

Table 1 provides a comparison between pooled patient, parent, and dentists' rankings of dental aesthetics. The median rankings of dental aesthetics as represented by the AC of the IOTN were similar among the three groups for all 10 photographs, with the exception of photograph 6 (Table 1). The median ranking of photographs 1, 2, 3, 4, and 10 were identical to the sequence of the AC of the IOTN.

 Table 1
 Comparison of rankings of dental aesthetics.

The photographs representing IOTN AC 7 and 8 were allocated the same median rank of 7 by patients, parents, and dentists (Table 1). Similarly, IOTN AC 5 and 9 were allocated corresponding median ranks of 6 and 8, respectively, by all three groups (Table 1). IOTN AC 6 was allocated a median rank of 6 by patients and dentists and a median rank of 6.5 by parents (Table 1). A Mann–Whitney test was used to compare rankings between patients, parents, and dentists. No statistically significant differences were found (P > 0.05). Figure 2 illustrates the similarity between patient, parent, and dentists ranking of dental aesthetics according to the AC of the IOTN.

Cut-off point for orthodontic treatment need

The median cut-off point for orthodontic treatment for females was photograph 3, whereas for males it was 2. As this difference was not statistically significant (P > 0.05), the data were pooled for further comparison.

Table 2 illustrates descriptive statistics of cut-off points for orthodontic treatment need selected by patients, parents, and dentists. The median cut-off point for dentists was highest at IOTN AC 3, followed by patients at 2.5 and parents at 2. These differences were not significant at the 5 per cent level.

Discussion

Ranking of dental aesthetics

Median patient rankings of dental aesthetics were similar among males and females for all 10 photographs of the AC of the IOTN. This finding agrees with previous studies (Burden and Pine, 1995; Mandall *et al.*, 1999; Hunt *et al.*, 2002; Hamdan, 2004). In contrast, some studies investigating self-perception of malocclusion have shown that females are more critical of their dental aesthetics (Shaw *et al.*, 1991; Holmes, 1992; Pietilä and Pietilä 1996; Tung and Kiyak, 1998).

AC/IOTN	Patients (n=100)			Parents (n=100)			Dentists (n=23)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
1	1.5	0.87	1	1.3	0.83	1	1.1	0.29	1
2	2.3	1.10	2	2.3	0.89	2	2.2	0.67	2
3	3.0	1.22	3	3.2	1.07	3	3.2	0.95	3
4	4.0	1.24	4	4.1	1.83	4	3.7	0.92	4
5	6.3	1.63	6	5.9	1.73	6	6.4	1.53	6
6	6.5	1.79	6	6.8	1.72	6.5	6.4	1.56	6
7	7.0	1.66	7	6.9	1.64	7	7.3	1.52	7
8	7.0	1.58	7	7.3	1.48	7	7.1	1.70	7
9	7.7	1.44	8	7.7	1.38	8	7.7	0.93	8
10	9.7	0.83	10	9.5	1.04	10	9.9	0.46	10

AC, aesthetic component; IOTN, Index of Orthodontic Treatment Need; SD, standard deviation.



Figure 2 Comparison of median ranking of dental aesthetics.

Table 2 Comparison of cut-off points for orthodontic treatmentneed.

	Mean	SD	Median
Patients	2.7	1.24	2.5
Parents	2.6	1.40	2.0
Dentists Mean of medians	2.9	1.10	3.0 2.5

SD, standard deviation.

One of the most surprising findings of the present study was that median rankings of dental aesthetics using the AC of the IOTN were similar among patients, parents, and dentists (Figure 2). Previous investigations using the AC of IOTN to assess treatment need found that clinicians' ratings were more critical than child or lay opinion (Shaw *et al.*, 1975; Prahl-Andersen *et al.*, 1979; Lindsay and Hodgkins, 1983; Stenvik *et al.*, 1997; Mandall *et al.*, 2001; Hamdan, 2004). Conversely, Mohlin *et al.* (2002) found that the majority of 12-year-old children judged their dental appearance as more attractive than average.

It must be noted that the sample of clinicians used in most of the previous studies were orthodontists and therefore likely to have some previous experience of the IOTN. Orthodontists were excluded from the present study, and although some of the dental specialists included may have had some knowledge of the IOTN, it is unlikely that they had any real experience using it. This may give some explanation for the similarity of rankings in the present research.

Studies have also shown differences between patient and parent concern (Roberts *et al.*, 1989; Birkeland *et al.*, 1996) and perceived need (Hamdan, 2004) for orthodontic treatment, with parents being more critical of dental aesthetics. The similarity of patient and parent rankings in the present investigation, compared with previous research, may be due to differences in study design. Previous investigations compared patients' self-assessments with parents' assessments of their child's AC grade (Birkeland et al., 1996; Hamdan, 2004). This may have introduced a source of bias since parents may have over scored treatment need in the hope of securing treatment for their children, because they felt a sense of obligation to provide them with the best possible care, or so that they would not be held accountable by their children in future for not providing treatment (Hamdan, 2004). In the present study, selfassessment was not carried out and the subjects were asked to arrange the 10 photographs of the AC from 'the one that looks best' to 'the one that looks worst'. It is likely that these rankings were more objective since they were not related to the patient or the provision of orthodontic treatment.

The median ranks of photographs 1, 2, 3, 4, and 10 were identical to the AC of the IOTN for all three groups of subjects (Table 1). Thus, malocclusions representing mild and severe aesthetic impairment were perceived and ranked similar to the AC of the IOTN by patients, parents, and dentists. This finding is in agreement with previous studies (Hamdan, 2004; Johansson and Follin, 2005). Hamdan (2004) compared clinician AC scores with patients' own and parents' scores and found that patients with more severe aesthetic impairment were more easily identified by all groups. Johansson and Follin (2005) evaluated whether orthodontists in Sweden agreed with the ranking of photographs of the AC of the IOTN. Orthodontists were presented with the 10 photographs in random order and asked to rank them from 1 (most aesthetic) to 10 (least aesthetic). The aesthetic ranking selected by most orthodontists was 1, 2, 3, 4, 6, 5, 7, 9, 8, and 10.

In the present study, the photographs representing AC 7 and 8 were allocated the same median rank of 7 by patients, parents, and dentists (Table 1). Similarly, photographs 5 and

6 were allocated a median rank of 6 by all three groups; the only exception was photograph 6 which was allocated a median rank of 6.5 by parents. These findings suggest that all three groups of subjects found little difference in dental aesthetics between photographs 5 and 6 on the one hand, and 7 and 8 on the other. The AC of the IOTN may therefore benefit from being modified to include only eight photographs rather than 10. A suggested sequence of photograph could be 1, 2, 3, 4, 6, 8, 9, and 10. Photographs would be sequentially numbered from 1 to 8. Care must be taken to test the validity of any modification to the AC on a fresh sample of subjects prior to clinical application. Burden (1995) reduced the AC to two anchor photographs, one at each end of the scale in an attempt to improve reliability and validity of the index among novice users. The results showed a tendency to underscore and reduced agreement with gold standard scores.

Table 1 shows that a median rank of 9 was not allocated to any of the photographs of the AC by any of the groups of subjects. The photograph representing AC 9 was allocated a median rank of 8. This presented a gap of 2 ranks between AC photograph 9 and 10. A possible explanation for this finding could be that the upper incisor teeth are relatively well aligned in AC 9, whereas in AC 10 they are severely malaligned and displaced. This finding requires further investigation.

Cut-off point for orthodontic treatment need

There was no statistically significant difference between cut-off points for orthodontic treatment need selected by males and females (P > 0.05) and data were therefore pooled for further comparison. The median cut-off points for orthodontic treatment need selected by dentists, patients, and parents were 3.0, 2.5, and 2.0, respectively (Table 2). These differences were not statistically significant (P > 0.05). The mean of patient, parent, and dentist cut-off point was 2.5 (Table 2); this number was rounded to 3 since there was no AC grade of 2.5.

According to the results of the present study, any malocclusion judged to have an aesthetic impairment of AC 4 or above was in need of treatment. Furthermore, a total of 157 subjects (70.4 per cent) would seek treatment at AC 4; these included 73 patients, 69 parents, and 15 dentists (65.2 per cent). These findings are in agreement with Hunt et al. (2002) where the AC of the IOTN was used to determine the threshold of aesthetic impairment where orthodontic treatment would be sought by a sample of lay people. They found that the no need for treatment category was represented by grades 1-3 and 74 per cent of the sample would seek treatment by grade 4. In a study of 12-year-old schoolchildren in Poland using the IOTN, Grzywacz (2003) found that the correlation between dental concern and the AC would be improved if the borderline need category was moved two grades lower, or the no need category was split into two parts (e.g. 1–2, no need; 3–4, slight need). An earlier investigation by Stenvik *et al.* (1997) comparing professionally defined cut-off values of the AC with the opinion of lay people indicated that subjects and professionals were in agreement, with grades 1–4 representing the no need for treatment category. Studies carried out to establish the validity and reliability of the AC of the IOTN found that grades 1–4 were representative of 'no need for treatment' (Richmond, 1990; Richmond *et al.*, 1995; Younis *et al.*, 1997; Johansson and Follin, 2005). It must be noted that the gold standard for assessment of aesthetic treatment need in the former studies was professional opinion orthodontists).

Care must be taken not to generalize the finding of the present study as there is evidence to suggest that ethnicity and culturally related differences may play a role in variations in assessments of dental aesthetics (Josefsson *et al.*, 2005; Reichmuth *et al.*, 2005).

It could be argued that the gold standard used for validation of occlusal indices should be specialists in orthodontics. However, there is evidence to suggest that while lay people seem mostly aware of their malocclusion, they do not perceive a need for treatment to the same extent as dentists or orthodontist (Kerr and O'Donnell, 1990; Espeland and Stenvik, 1991; Phillips et al., 1992; Mandall et al., 1999; Hunt et al., 2002; Hamdan, 2004). Factors that may contribute to these differences are social class, economic considerations, individual perceptions of psychosocial benefits, and attitudes to appliances (Birkeland et al., 1996). Therefore, using specialist opinion as the gold standard may represent a biased view of a small group rather than a wider view of society. Furthermore, the success of orthodontic treatment depends on a balance between patients' and their parents' perceived needs and orthodontists' objective assessment of the patient's orthodontic problems (Reichmuth et al., 2005).

Conclusions

- 1. Median ranking of dental aesthetics using the AC of the IOTN was similar among patients, parents, and dental specialists.
- 2. Malocclusions representing mild and severe aesthetic impairment were perceived and ranked similar to the AC of the IOTN by patients, parents, and dental specialists.
- 3. Subjects found little differences in dental aesthetics between photographs 5 and 6 on the one hand, and 7 and 8 on the other. It is suggested that the AC of the IOTN may need to be modified accordingly to include only eight photographs. Further investigation is required for validation.
- 4. The threshold at which orthodontic treatment would be sought by all three groups of subjects was AC grade 4.

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