ORIGINAL ARTICLE

The relationship of 2 professional occlusal indexes with patients' perceptions of aesthetics, function, speech, and orthodontic treatment need

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The aim of this study was to determine the relationship between patients' perceptions of orthodontic treatment need and need as determined with professionally derived indexes, namely the dental aesthetic index and the index of orthodontic treatment need. This study was undertaken at orthodontic offices in San Francisco, Calif. The pretreatment study casts of 50 consecutive patients, presenting for orthodontic treatment, were objectively assessed with these indexes by 2 examiners trained and calibrated in their use. Patients were asked to complete a questionnaire consisting of 4 questions addressing appearance, function, speech, and treatment need, using either a 5-point Likert scale or a yes/no response. The professionally derived indexes showed that statistically significant correlations existed between the aesthetic component and dental health component (r = 0.46; P < .01), the aesthetic component and dental aesthetic index (r = 0.54; P < .01), and the dental health component and dental aesthetic index (r = 0.46; P < .01). Statistically significant correlations were also found for subjective assessments between biting/chewing and speech (r = 0.31; P < .05), between speech and the aesthetic component (r = -0.39; P < .01) and the dental aesthetic index (r = 0.34; P < .05), and between the aesthetic component and appearance (r = –0.28; P < .05). Logistic regression analysis after dichotomization (treatment/no treatment need) confirmed that the aesthetic component was the only statistically significant factor (odds ratio, 0.57; 95% confidence limits 0.34 to 0.97). (Am J Orthod Dentofacial Orthop 2000;118:421-8)

Over the years, a variety of indexes have been developed to assist professionals in categorizing malocclusion according to the level of treatment need. Examples of such indexes are Summers' occlusal index,[1] Salzmann's handicapping malocclusion assessment record,[2] and Grainger's treatment priority index.[3] These indexes were developed in the late 1960s and early '70s, primarily for epidemiologic purposes, but they have also been used to determine treatment priority. New indexes for the assessment of malocclusion and determination of treatment need have also been developed, including the dental aesthetic index (DAI)[4] and the index of orthodontic treatment need (IOTN).[5]

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The DAI was developed in the United States. It identifies deviant occlusal traits and mathematically derives a single score. Its structure consists of 10 prominent traits of malocclusion, weighted on the basis of their relative importance according to a panel of lay judges. The DAI has been used in epidemiologic studies of orthodontic treatment need,[6,7] and it was integrated into the items of the International Collaboration Study of Oral Health Outcomes by the World Health Organization in 1989.[8]

The IOTN was developed in the United Kingdom. It incorporates an aesthetic component (AC) and a dental health component (DHC). The AC consists of a 10-point scale illustrated by a series of photographs that were rated for attractiveness by a panel of lay judges and selected as being equidistantly spaced through the range of grades.[9] The DHC has 5 categories, ranging from 1 (no need for treatment) to 5 (great need), that can be applied to patients or study casts. The IOTN has been increasingly used as a tool for research and administration of public health service orthodontics.[10] Furthermore, the AC of IOTN has been used in patient education.[11] It is simple to use, and scores obtained from clinicians, children, and parents have shown very good agreement levels.[9]

Patients' opinions regarding orthodontic treatment need have previously been recorded for dental and facial appearance,[12-16] and patients' concerns do not

Table I. Components of the DAI regression equation and their actual and rounded regression coefficients (weights)

DAI components		*Regression coefficients*	
		Actual weights	*Rounded weights*
1.	Number of missing visible teeth (incisors, canines, and premolars in the maxillary and mandibular arches)	5.76	6
2.	Assessment of crowding in the incisal segments: 0 = no segments crowded; 1 = 1 segment crowded; 2 = 2 segments crowded	1.15	1
3.	Assessment of spacing in the incisal segments: 0 = no segments spaced; 1 = 1 segment spaced; 2 = 2 segments spaced	1.31	1
4.	Measurement of any midline diastema in mm	3.13	3
5.	Largest anterior irregularity on the maxilla in mm	1.34	1
6.	Largest anterior irregularity on the mandible in mm	0.75	1
7.	Measurement of anterior maxillary overjet in mm	1.62	2
8.	Measurement of anterior mandibular overjet in mm	3.68	4
9.	Measurement of vertical anterior openbite in mm	3.69	4
10.	Assessment of anteroposterior molar relation; largest deviation from normal either left or right, 0 = normal, 1 = ½ cusp either mesial or distal, 2 = 1 full cusp or more either mesial or distal.	2.69	3
Constant		13.36	13
Total		DAI score (actual)	DAI score (rounded)

always coincide with professional evaluations of treatment need.[17-19]

The purpose of this study was to objectively assess the relationship between DAI, IOTN, and patients' opinions regarding malocclusion and treatment need. These two indexes were chosen for this study as they both contain aesthetic and anatomic components of malocclusion for the assessment of treatment need.

SUBJECTS AND METHODS

This study was undertaken at orthodontic offices in San Francisco, Calif. Fifty consecutive patients, aged 11 to 14 years and presenting for orthodontic treatment, were recruited. Individuals with mental and/or physical impairment and those who had previously undergone orthodontic treatment were excluded from the study. Professional assessments were obtained by objectively evaluating the pretreatment study casts on the basis of the DAI and IOTN guidelines (Tables I and II, and Fig 1) by 2 examiners who were trained and calibrated in the use of these indexes. Subjective assessments were obtained from patients by means of a questionnaire consisting of 4 simple questions (Table III). A 5-point Likert scale was used for the 3 questions that addressed aesthetics, function, and speech. The treatment need decision was determined by a yes/no question.

Statistical Analysis

The kappa statistic (κ) was used to analyze intraexaminer and interexaminer reliability for IOTN, and the root mean square (RMS) was used for the DAI.[20] Spearman rank correlation coefficients were used to explore the relationships between the various factors. Logistic regression analysis (based on the patients subjective treatment decision, question 4) with forward stepwise condition was used to determine predictive factors. The factors entered into the forward conditional model were age, gender, aesthetic component, dental health component, dental aesthetic index, and the 4 questions. Finally, cut-off points for the indexes were explored based on previously published criteria.[21,22]

RESULTS

High levels of reliability were achieved with both IOTN and DAI. RMS < 2.4 was achieved for DAI. The reliability of IOTN is shown in Table IV.

The mean age of patients was 12.6 years (SD 1.3). There were 24 males and 26 females. Distribution of the subjective and objective scores is shown in Figs 2 and 3.

The relationship between the various factors explored using the Spearman rank correlation coefficient is shown in Table V. With professionally derived indexes, there were statistically significant correlations between the aesthetic and dental health components ($R = 0.46$; $P < .01$), aesthetic component and dental aesthetic index ($R = 0.54$; $P < .01$), and dental health component and dental aesthetic index ($R = 0.46$; $P < .01$). Statistically significant correlations were also found for subjective assessments between biting/chewing and speech ($R = 0.31$; $P < .05$) and between speech and the aesthetic component ($R = –0.39$; $P < .01$) and dental aesthetic index ($R = –0.34$; $P < .05$), as well as between aesthetic component and appearance ($R = –0.28$; $P < .05$).

Table II. Index of orthodontic treatment need: Dental health component (DHC)

Grade 1 (none)	
1	Extremely minor malocclusions including displacements less than 1 mm.
Grade 2 (little)	
a	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with competent lips.
b	Reverse overjet greater than 0 mm but less than or equal to 1 mm.
c	Anterior or posterior crossbite with less than or equal to 1 mm discrepency between retruded contact position and intercuspal position.
d	Displacement of teeth greater than 1 mm but less than or equal to 2 mm.
e	Anterior or posterior open bite greater than 1 mm but less than or equal to 2 mm.
f	Increased overbite greater than or equal to 3.5 mm without gingival contact.
g	Prenormal or postnormal occlusions with no other anomalies. Includes up to half a unit discrepency.
Grade 3 (moderate)	
a	Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips.
b	Reverse overjet greater than 1 mm but less than or equal to 3.5 mm.
c	Anterior or posterior crossbites with greater than 1 mm but less than or equal to 2 mm discrepency between retruded contact position and intercuspal position.
d	Displacement of teeth greater than 2 mm but less than or equal to 4 mm.
e	Lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm.
f	Increased and complete overbite without gingival or palatal trauma.
Grade 4 (great)	
a	Increased overjet greater than 6 mm but less than or equal to 9 mm.
b	Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties.
c	Anterior or posterior crossbites with greater than 2 mm discrepency between retruded contact position and intercuspal position.
d	Severe displacements of teeth greater than 4 mm.
e	Extreme lateral or anterior open bites greater than 4 mm.
f	Increased and complete overbite with gingival or palatal trauma.
h	Less extensive hypodontia requiring prerestorative orthodontics or orthodontic space closure to obviate the need for a prosthesis.
l	Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments.
m	Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory and speech difficulties.
t	Partially erupted teeth, tipped and impacted against adjacent teeth.
x	Supplemental teeth.
Grade 5 (very great)	
a	Increased overjet greater than 9 mm.
h	Extensive hypodontia with restorative implications (more than 1 tooth missing in any quadrant) requiring prerestorative orthodontics.
i	Impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathologic cause.
m	Reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties.
p	Defects of cleft lip and palate.
s	Submerged deciduous teeth

Logistic regression analysis after dichotomization (treatment/no treatment need) confirmed that the aesthetic component was the only statistically significant factor. No other factor significantly added to the predictive power of the model (odds ratio 0.57; 95% confidence limits, 0.34 to 0.97).

Using the levels of discrimination between minor deviant occlusal anomalies and definite malocclusions (aesthetic component ≥4, dental health component ≥3, and dental aesthetic index ≥25) 48, 42, and 48 patients, respectively, would be categorized as needing orthodontic treatment.[21,22]

Only 6 patients stated that they did not think they needed orthodontic treatment. For these cases the aesthetic component scores ranged from 2 to 9, the dental health component from 2 to 4, and the dental aesthetic index from 12 to 31.

DISCUSSION

The importance of patients' perceptions regarding orthodontic treatment cannot be underestimated, as it is the patients who receive treatment and need to gain satisfaction from improved aesthetics and function.

DAI and IOTN both attempt to incorporate these patient perceptions in their respective indexes. Studies investigating the correlation of orthodontic indexes with patient perceptions have been carried out,[23-25] but no study to date has objectively assessed the correla-

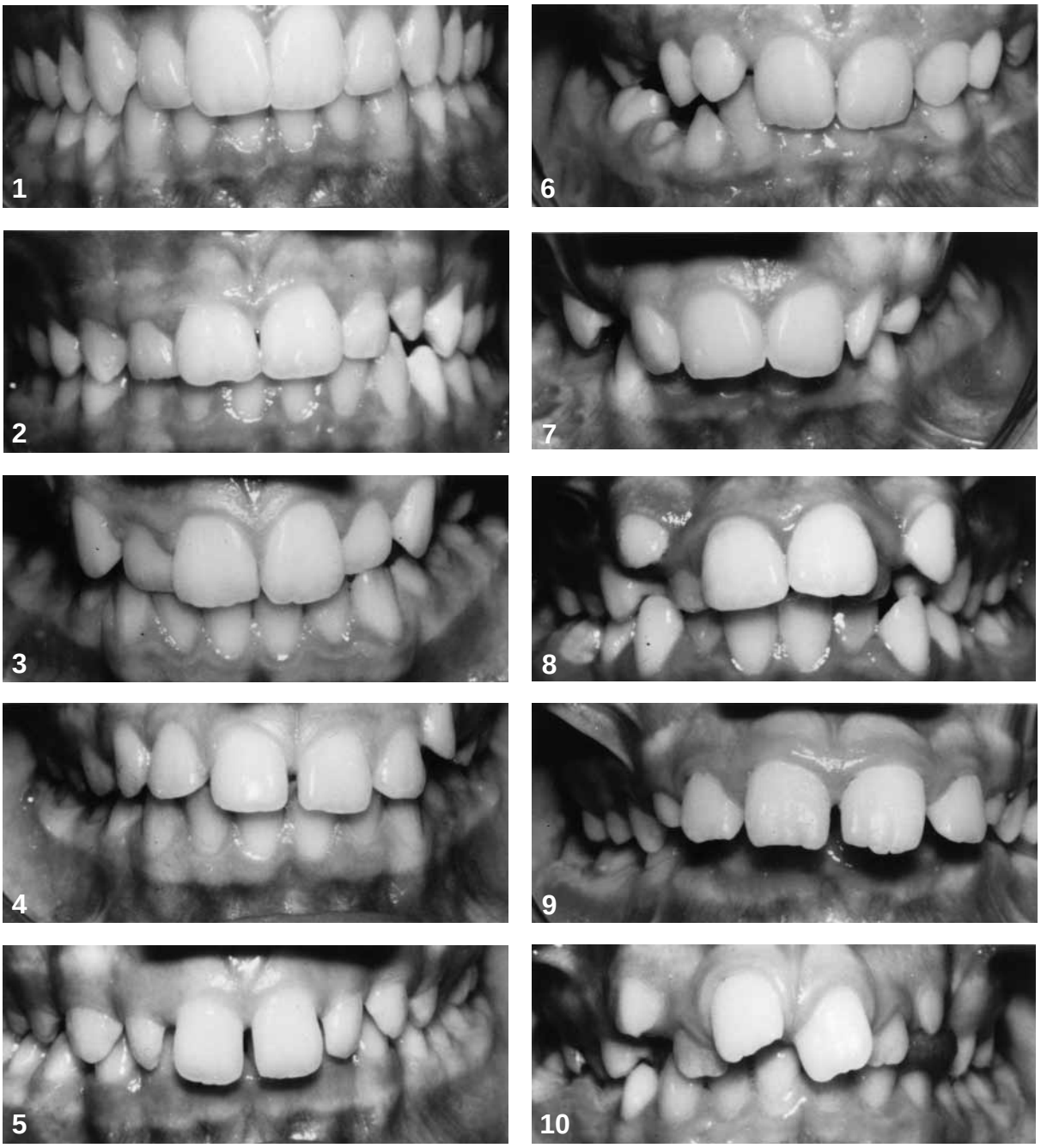

Fig 1. Index of orthodontic treatment need, aesthetic component (AC). The SCAN scale was first published by the European Orthodontic Society. (Evans MR, Shaw WC .Eur J Orthod 1987;9:314-8)

tion of patient perceptions of their own occlusion with DAI and IOTN. Indeed, very few studies have objectively compared the two indexes.[26,27]

The findings of this study indicate that both indexes can identify deviant occlusal traits. There are statistically significant correlations between both components of the index of orthodontic treatment need and the dental aesthetic index. The association between patients' perceptions of appearance and speech appears to be weak. In addition, the correlation of the aesthetic component and dental aesthetic index and speech suggests that this association is more than

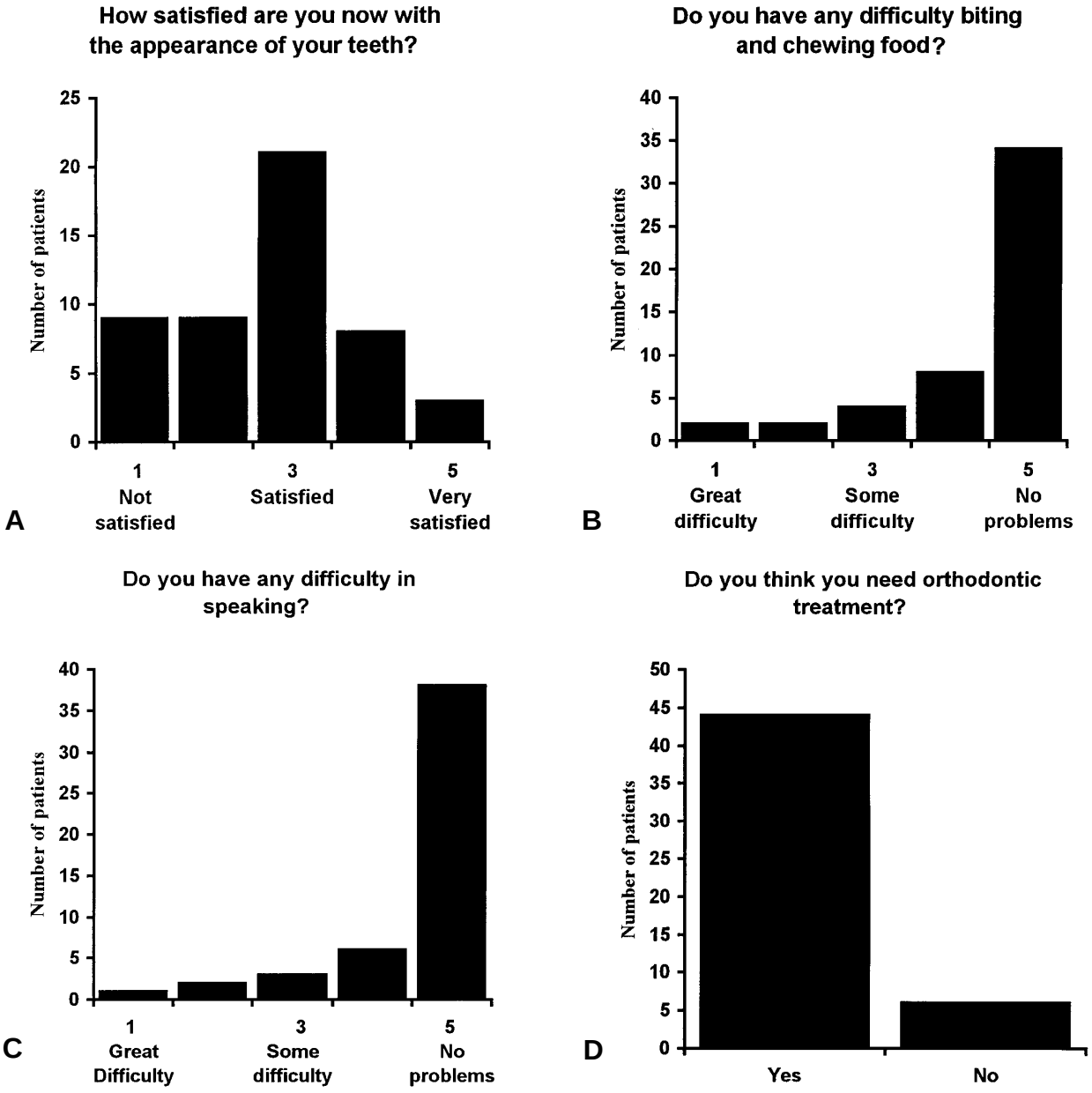

Fig 2. Distribution of subjective assessments using 5-point Likert scales.

coincidental and warrants further investigation. The strongest association was between the aesthetic component and the dental aesthetic index. The aesthetic component also showed the strongest association with the subjective questions relating to appearance and speech but, surprisingly, not biting or chewing.

The two indexes investigated in this study may initially seem very similar. On application, however, differences become apparent. Although the DAI appears to be easier to use, the lack of assessment of traits such as buc-

Table III. 1. Subjective Assesment Questionnaire

1.	How satisfied are you now with the appearance of your teeth?				
	Not satisfied		Satisfied		Very satisfied
	1	2	3	4	5
2.	Do you have any difficulty biting and chewing food?				
	Great difficulty		Some difficulty		No problems
	1	2	3	4	5
3.	Do you have any difficulty in speaking?				
	Great difficulty		Some difficulty		No problems
	1	2	3	4	5
4.	Do you think you need orthodontic treatment? Yes/No				

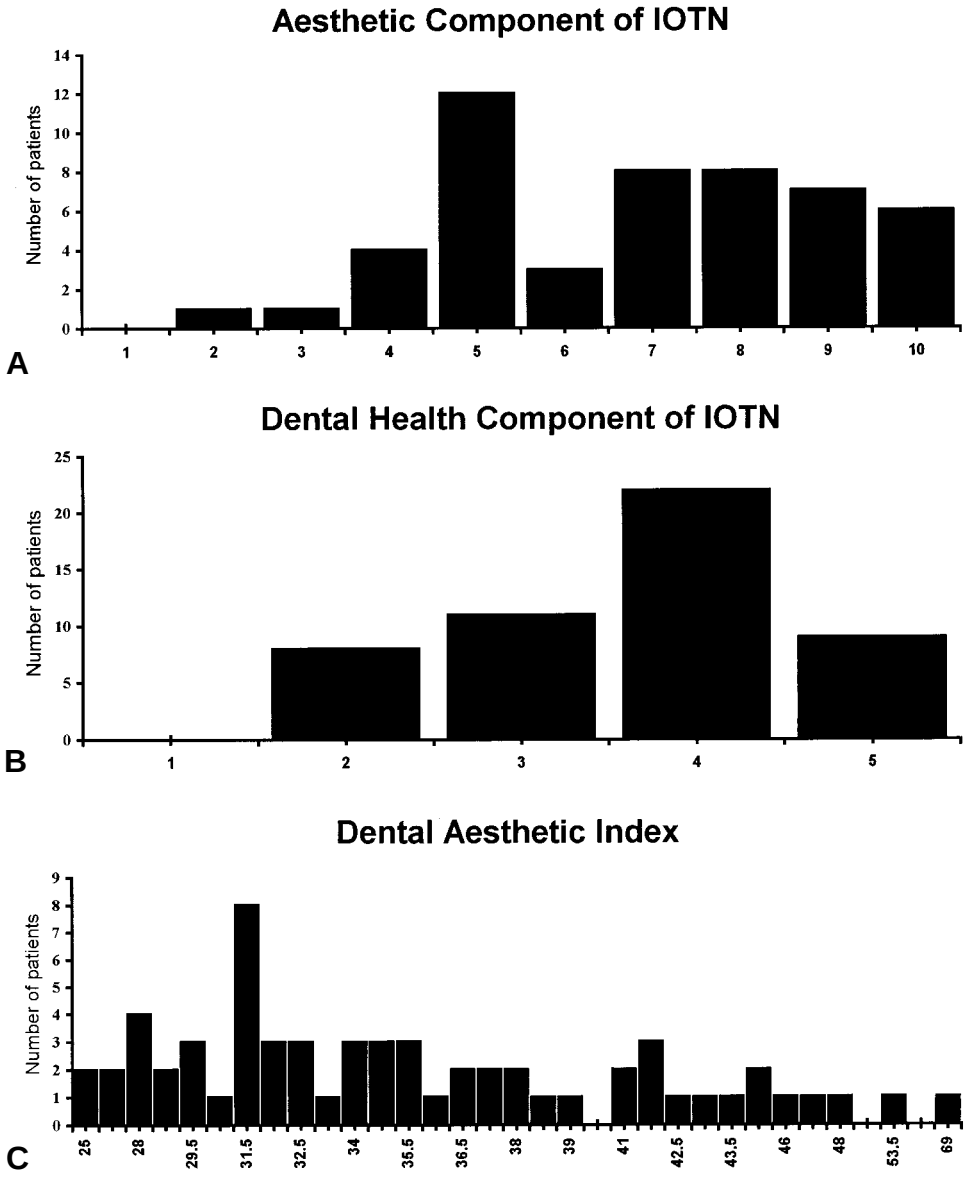

Fig 3. Distribution of professional assessments using AC, DHC, and DAI.

Table IV. Lower 95% confidence limits for reliability of IOTN (Kappa)

IOTN component	*Examiner 1*	*Examiner 2*
AC	0.65	0.66
DHC	0.81	0.77

cal crossbite, open bite, center line discrepancy, and deep overbite weakens that index.[28,29] In addition, DAI measurements are made using a millimeter gauge, and small errors in accuracy can have an exaggerated effect because of the index weightings. The IOTN proved to be more accurate in assessing patients' perceptions of both aesthetics and treatment need, and cut-off points determined with IOTN were similar to those previously established. Future studies with larger samples and in different populations are needed to corroborate these findings.

The 6 patients who recorded they did not require orthodontic treatment reinforces the fact that patient's concerns do not always coincide with professional evaluations of treatment need.

The low correlation of the aesthetic component with the patients' perception of appearance and speech

Table V. Correlation of professionally derived indexes and subjective assessments

	AC	*DHC*	*DAI*	*Q1 (Appearance)*	*Q2 (Biting and chewing)*	*Q3 (Speech)*
AC		0.46**	0.54**	–0.28*	–0.03	–0.39**
DHC	0.46**		0.46**	–0.14	0.13	0.07
DAI	0.54**	0.46**		–0.03	–0.04	–0.34*
Q1 (Appearance)	–0.28*	–0.14	–0.03		–0.11	0.06
Q2 (Biting and chewing)	–0.03	0.13	–0.04	–0.11		0.31*
Q3 (Speech)	–0.39**	–0.07	–0.34*	0.06	0.31*	

*Correlation significant at 0.05 level.
**Correlation significant at 0.01 level.

requires further exploration in larger population samples with specific malocclusion types, such as increased overjet and open bite, etc.

CONCLUSION

Both the index of orthodontic treatment need and the dental aesthetic index reliably record deviant occlusal traits. The aesthetic component correlates well with the dental aesthetic index and subjective assessments of appearance and speech. The aesthetic component was the only statistically significant factor for the predictive model in assessing patients' perceptions of orthodontic treatment need.

Further studies will be required with larger samples in different population groups in the general population to confirm the usefulness of the aesthetic component of the index of orthodontic treatment need.

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