Dental Aesthetic Index scores and perception of personal dental appearance among Turkish university students

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SUMMARY The aim of this study was to investigate the relationship between Turkish university students' awareness of malocclusion, their satisfaction with their personal dental appearance, and the severity of their occlusal irregularities. The sample consisted of 841 randomly selected university students, 522 (62.1 per cent) males and 319 (37.9 per cent) females, aged 17–26 years (mean age, 21.91 ± 1.92 years). A pretested questionnaire was used to assess the subjects' awareness of malocclusion and satisfaction with their personal dental appearance; the actual severity of malocclusion was determined using the Dental Aesthetic Index (DAI). Statistical analysis was carried out using chi-square for gender differences and Spearman rank-order correlation coefficients for awareness of malocclusion, satisfaction with personal dental appearance, and DAI scores. Analysis of variance and univariate analysis, with age and gender as the independent variables, were further used to analyse the data.

Weak but statistically significant, negative, correlations were found between awareness of malocclusion and satisfaction at the following DAI scores: ≤ 25 (r=-0.264, P < 0.001), 26–30 (r = -0.381, P < 0.001), and ≥ 36 (r = -0.477, P < 0.001), and a statistically insignificant, negative correlation at a score of 31–35 (r = -0.102, P > 0.05). A statistically significant association was found between DAI and awareness of malocclusion (r=-0.305) and satisfaction with dental appearance (r=0.234). There were no significant associations between the department in which the individuals studied and the investigated variables (P > 0.05). DAI scores were significantly higher for females. Generally, no statistically significant gender differences were found in relation to DAI scores, awareness, or satisfaction (P > 0.05). The findings of this study showed that age had a significant effect on satisfaction and gender on DAI score variation. Females had a greater need for normative treatment except in the 20- to 22-year-olds, and satisfaction decreased with age.

Introduction

Increased concern over dental appearance has been observed during childhood and adolescence to early adulthood (Shaw *et al.*, 1975; Gosney, 1986: Espeland, 1993). The decision to start orthodontic treatment is primarily influenced by such concerns and psychosocial well-being (Albino *et al.*, 1981; Shaw, 1981; Tedesco *et al.*, 1983). Social interactions that have a negative effect on self-image, career advancement, and peer-group acceptance have been associated with an unacceptable dental appearance (Berscheid, 1980; Jenny and Proshek, 1986; Adams, 1997) The public equates a 'good dental appearance' with success in many pursuits (Linn, 1966; Samuels and Proshek, 1973).

The relationship between professionally assessed and self-perceived treatment need is of interest to providers of orthodontic services. In general, the need for normative treatment has been reported to be higher than that expressed by the subjects themselves (Shaw *et al.*, 1991; Tuominen *et al.*, 1995; Sheats *et al.*, 1998). A level of less than 60 per cent agreement between the need for normative treatment and individual demand for treatment has been found (Tang and So, 1995).

In general, societal forces define the norms for an acceptable, normal, and attractive physical appearance (Strauss, 1980). Identification by children and their parents of abnormal, unacceptable, and disfiguring dentofacial characteristics is influenced as much by social context and cultural milieu as by objective criteria (Mechanic, 1974; Jenny, 1975). Although dissatisfaction with dental appearance is broadly related to the severity of occlusal irregularities (Albino et al., 1981; Shaw, 1981; Tedesco et al., 1983), there are differences in the recognition and evaluation of dental features (Shaw et al., 1975; Lucker and Graber, 1978; Albino et al., 1979; Prahl-Andersen et al., 1979; Brisman, 1980). High correlations have been reported between dental aesthetics, need for treatment, and severity of malocclusion in clinical assessments (Lewis et al., 1982).

Over the years, a variety of indices have been developed to assist professionals in categorizing malocclusion according to the level of treatment need: the Occlusal Index (Summers, 1971), the Handicapping Malocclusion Assessment record (Salzmann, 1968), and the Treatment Priority Index (Grainger, 1967). These indices were developed in the late 1960s and early 1970s, primarily for epidemiological purposes, but they have also been used to determine treatment priority.

The Dental Aesthetic Index (DAI), developed in the United States of America and integrated into the International Collaboration Study of Oral Health Outcomes by the World Health Organization (WHO, 1989) as an international index, identifies occlusal traits and mathematically derives a single score. As dental auxiliaries can use the DAI to determine which patients to refer to a specialist, this can reduce the number of initial consultations by dentists or orthodontists, an important advantage in public health programmes (Spencer et al., 1992). DAI scores have also been found to be significantly associated with the perception of treatment need by students and parents (Cons et al., 1987; Spencer et al., 1992), and these are good predictors of the acceptance of future fixed orthodontic therapy (Jenny and Cons, 1996b).

The DAI links clinical and aesthetic components mathematically to produce a single score that combines physical and aesthetic aspects of occlusion, including patient perceptions. The DAI equation loses some precision when regression coefficients (weights) are rounded off, but this is offset by convenience in many clinical and research applications (Cons et al., 1987).

The purpose of this study was to investigate the possible relationship between Turkish university students' awareness of malocclusion, their satisfaction with their personal dental appearance, and the severity of their occlusal irregularities as assessed using the DAI.

Subjects and methods

Approval for the study was received from the Faculty of Dentistry of Dicle University, and informed consent was obtained from the subjects.

The sample comprised 841 university students, 522 (62.1 per cent) males and 319 (37.9 per cent) females, aged 17-26 years, with a mean age of 21.91 ± 1.92 years, randomly drawn from Dicle University, Diyarbakır, Turkey.

The subjects were asked to fill in a questionnaire and were then examined by one orthodontist without knowledge of their responses. The study population consisted solely of orthodontically untreated university students selected by simple randomized sampling. They were divided into two groups, health and social, according to the departments in which they were studying. Individuals in the 'health group' were selected from the dental and medical faculties and those in the 'social group' from faculties such as literature, law, and education. Information on awareness of malocclusion and satisfaction with personal dental appearance was obtained from two items in the questionnaire, each having four fixed alternative answers (Table 1). The questions were modified from previous studies (Fox et al., 1982; Birkeland et al., 1996; Onyeaso and Sanu, 2005). Respondents who indicated options 'a' or 'b' for awareness of malocclusion were regarded as having such awareness and those indicating 'c' or 'd' were

 Table 1
 Questionnaire used in the study.

1	Awareness	of	ma	loce	lusion	
1.	Awareness	01	ma	IUCC.	lusion	

Do you find that your teeth are irregular	or
come together in a wrong way?	

- a. Yes, very
- b. Yes, somewhat
- c. Not really
- d. No, not all
- 2. Satisfaction with dental appearance
- I am satisfied with the way my teeth come together or the appearance of my teeth.
- a. Agree very much
- b. Agree a little
- d. Disagree very much
- c. Disagree a little

considered as having no such awareness. Similarly, those who chose 'a' or 'b' for satisfaction were regarded as showing satisfaction with personal dental appearance and those who indicated 'c' or 'd' were considered to be dissatisfied.

The students' occlusions were objectively determined by one author (NH) using the DAI according to the WHO (1997) guidelines. All 10 components of the index were assessed (Table 2).

To ascertain intraexaminer reliability in the use of the DAI, 40 students were re-examined after a period of 3-4 weeks by the same examiner. The results were tested using Wilcoxon signed-rank test.

Statistical analysis

A chi-square test was used to analyse gender differences, and Spearman rank-order correlation coefficients were employed to determine the correlation between the various factors of awareness of malocclusion, satisfaction with personal dental appearance, and severity levels of occlusal irregularities (DAI scores). Analysis of variance (ANOVA) and univariate analysis with age and gender as the independent variables were further used to analyse the data. All analyses were performed using the Statistical Package for Social Sciences (Windows, release 6.0 SPSS Inc., Chicago, Illinois, USA).

Results

There was no statistically significant difference between the measurements for reliability (P=0.418). The computed intrarater correlation coefficient for repeated measurements was 0.98 (P < 0.001), indicating high reliability.

The age and gender distribution of the study sample are shown in Table 3.

Table 4 shows the Spearman rank-order correlation coefficients between the subject's satisfaction with their personal dental appearance and awareness of malocclusion according to DAI scores, with statistically significant, negative, weak correlations at all levels of treatment need

 Table 2
 Standard dental aesthetic index scoring table.

DAI component	Rounded weight
 Number of missing visible teeth (incisors, canines, and premolars in maxillary and mandibular arch) 	6
2. Crowding in incisal segment (0=no segments crowded, 1=1 segment crowded 2=2 segments crowded)	1
 Spacing in incisal segment (0=no spacing, 1=1 segment spaced, 2=2 segments spaced) 	1
4. Midline diastema, in millimetres	3
5. Largest anterior maxillary irregularity, in millimetres	1
6. Largest anterior mandibular irregularity, in millimetres	1
7. Anterior maxillary overjet, in milimetres	2
8. Anterior mandibular overjet, in millimetres	4
9. Vertical anterior openbite, in millimetres	4
 Anteroposterior molar relationship, largest deviation from normal either left or right (0=normal, 1=¹/₂ cusp mesial or distal, 2=1 full cusp or more mesial or distal) 	3
11. Constant	13
Total	DAI score

(Cons *et al.*, 1987) reproduced with kind permission of Frank Kohout, Professor Emeritus, College of Dentistry, University of Iowa.

Table 3 Age and gender distribution of the study sample.

Age groups (years)	Gender								
	Female	;	Male		Total				
	n	%	n	%	n	%			
17–19	19	38.8	30	61.2	49	5.8			
20-22	173	42.1	238	57.9	411	48.8			
23-26	127	33.3	254	66.7	381	45.3			
Total	319	37.9	522	62.1	841	100.0			

(P < 0.001), except for the 31–35 level, at which there was a negative, weak correlation, although this was not statistically significant. Negative, weak correlations were observed between awareness of malocclusion and satisfaction with personal appearance, according to DAI malocclusion severity levels (treatment need), DAI scores of 25 or less; 26–30; 31–35; and 36 and above.

Separate correlations of DAI with awareness of malocclusion (r=-0.305) and satisfaction with personal dental appearance were statistically significant (r=0.234). A significant association was found between DAI and the subject's awareness of malocclusion and satisfaction with personal dental appearance.

ANOVA results for awareness, satisfaction, and DAI scores and descriptive statistics by gender and age are shown in Table 5.

Association between the department in which individuals studied, awareness, satisfaction, and DAI scores did not reveal any significant differences (P > 0.05), Table 6.

 Table 4
 Spearman correlation between subject's satisfaction

 with dental appearance and awareness of malocclusion according
 to Dental Aesthetic Index (DAI) treatment need.

DAI score groups								
≤25	26–30	31–35	≥36					
Normal or minor malocclusion; no or slight treatment need	Definite malocclusion; treatment need	Severe malocclusion; treatment highly decirable	Very severe (handicapping) malocclusion; treatment mandatory					
r=-0.264 (559)*	r=-0.381 (101)*	r = -0.102 (81)	$r = -0.477 (100)^*$					

*Correlation significant at the 0.001 level (two tailed; values in parentheses are the number of subjects).

The distribution of responses to the questionnaire are shown in Table 7. No statistically significant gender differences were observed (P > 0.05).

Discussion

The desire for treatment by individuals who are dissatisfied with their appearance underlies most orthodontic treatments. For this reason, the orthodontist's objective is to improve the function and appearance and to ensure patient satisfaction at the end of treatment. Patients' awareness of their appearance and their satisfaction are therefore important to orthodontists. Various indices for the evaluation of individuals have been developed in order to assist orthodontists in assessing these.

The DAI attempts to incorporate patients' perceptions into the index. Unlike the Index of Orthodontic Treatment Need (IOTN), the DAI links the clinical and aesthetic components mathematically to produce a single score that combines the physical and aesthetic aspects of occlusion (Jenny and Cons, 1996a). The aesthetic component of the DAI is based on public perception of the dental aesthetics of 200 photographs of the occlusion. The disproportionate, stratified, random sampling procedure used in the selection of the 200 photographs ensured that even the most extreme cases would be represented.

The DAI appears to be easy to use, although the lack of assessment of traits such as buccal crossbite, open bite, centerline discrepancy and deep overbite is a limitation of this index (Otuyemi and Noar, 1996a,b). In addition, DAI measurements are carried out using a millimetre gauge, and small errors in accuracy can have an exaggerated effect due to the index weightings.

The advantage of the DAI is that perceptions of aesthetics are linked with anatomical trait measurements by regression analysis to produce a single score, obviating the need for two separate instruments that cannot be combined, as in the IOTN (Jenny and Cons, 1996a). DAI scores are significantly associated with perception of need for treatment by patients

Source of variat	ion					Sum of squares	DF	Mean square	F	Р
Awareness										
Gender-age						5.53	2	2.76	3.376	0.035*
Gender		Male		Female		4.31	1	4.31	0.005	0.942
Age	17–19	Mean 2.66	SE 0.16	Mean 2.52	SE 0.20					n.s.
-	20-22	2.35	0.05	2.57	0.06	1.31	2	0.65	0.803	0.448 n.s.
	23-26	2.47	0.05	2.37	0.08					
Satisfaction										
Gender-age						8.76	2	4.38	5.265	0.005*
Gender		Male		Female		0.28	1	0.28	0.343	0.558
		Mean	SE	Mean	SE					n.s.
Age	17-19	1.76	0.16	1.89	0.20					
	20-22	2.07	0.05	1.87	0.06	7.65	2	3.82	4.597	0.010**
	23-26	2.02	0.05	2.26	0.08					
DAI scores										
Gender-age						11.7	2	5.86	5.273	0.005*
Gender		Male		Female		9.51	1	9.511	8.546	0.004*
		Mean	SE	Mean	SE					
Age	17-19	1.03	0.19	1.89	0.24					
-	20-22	1.72	0.06	1.64	0.08	2.78	2	1.394	1.253	0.286
										n.s.
	23-26	1.60	0.06	1.84	0.09					

Table 5 Analysis of variance for awareness, satisfaction and Dental Aesthetic Index (DAI) scores by gender and age.

* *P* < 0.05, ***P* < 0.01, n.s. not significant.

Table 6 Association between department in which the individuals studied, awareness, satisfaction, and Dental Aesthetic Index (DAI) score.

Variable	Department in which individuals studied										
	Health		Social		Total		χ^2	P value			
	n	%	n	%	n	%					
Awareness											
Aware	196	48.2	211	51.8	407	48.4	0.75				
Unaware	222	51.2	212	48.8	434	51.6		n.s.			
Satisfaction											
Satisfied	290	48.5	308	51.5	598	71.1	1.11				
Dissatisfied	128	52.7	115	47.3	243	28.9		n.s.			
DAI scores											
≤26	272	48.7	287	51.3	559	66.5	18.719				
26-30	65	64.4	36	35.6	101	12.0					
31-35	27	33.3	54	66.7	81	9.6		n.s.			
≥36	55	55	45	45	100	11.9					

n.s., not significant.

and parents (Cons *et al.*, 1987; Spencer *et al.*, 1992), and they are good predictors of the receipt of future fixed orthodontic treatment (Jenny and Cons, 1996b).

The results of the present study show that Turkish university students' awareness of their malocclusions did not agree with their objectively determined orthodontic need. The DAI and satisfaction with dental appearance were found to be different from each other. This finding is in agreement with studies performed in other communities (Onyeaso, 2002; Onyeaso and Aderinokun, 2003; Onyeaso and Sanu, 2005) but in contrast to those found by Yeh et al. (2000).

The relatively poor dental awareness in Turkey (Altun *et al.*, 2005) could explain both the significant negative correlation between DAI and awareness of malocclusion and the negative correlations of awareness and satisfaction with DAI scores at various levels of orthodontic need. This finding is in agreement with those of Onyeaso and Sanu (2005).

A statistically significant decrease in satisfaction in the older age groups was observed. DAI scores were also

Gender									
Responses to variables	Male		Female		Total		χ^2	P value	
	n	%	n	%	n	%			
Awareness									
Aware	254	62.4	153	37.6	407	48.4	0.038	n.s.	
Unaware	268	61.8	166	38.2	434	51.6			
Satisfaction									
Satisfied	364	60.9	234	39.1	598	71.1	1.265	n.s.	
Dissatisfied	158	65.0	85	35.0	243	28.9			

 Table 7
 Distribution of responses to the questionnaires.

n.s., not significant.

statistically significantly higher for females compared with males. However, there was no difference in satisfaction levels between males and females. This finding is in contrast to the study of Onyeaso and Sanu (2005).

No significant gender differences were found in relation to either subject's awareness or satisfaction. This finding is consistent with previous reports (Helm, 1968; Onyeaso, 2003; Onyeaso and Sanu, 2005).

The current evidence regarding the influence of gender, socio-economic standards, and area of residence on both normative and perceived need for orthodontic treatment is not consistent. Higher normative treatment needs for males than for females have been reported (Holmes, 1992; Burden *et al.*, 1994; Kerosuo *et al.*, 2000; Esa *et al.*, 2001), but no gender differences for self-perceived need (Tang and So, 1995; Bergström *et al.*, 1998; Kerosuo *et al.*, 2000), and a higher need for females than for males has been suggested (Holmes, 1992; Tuominen *et al.*, 1994). Females were found to have a higher normative treatment need than males except in the 20- to 22-year-old group in the present investigation, although the department in which individuals were studying did not affect normative treatment need.

The evidence for the role of gender and socio-economics in orthodontic treatment need varies; some reports have determined them to be significant, while others have not (Shaw *et al.*, 1991; Burden *et al.*, 1994; Bergström *et al.*, 1998; Kerosuo *et al.*, 2000). No gender differences in the total frequency of malocclusion have been observed among population groups with low orthodontic treatment experience (Helm, 1968; Kerosuo *et al.*, 2000). However, because females tend to seek treatment more often than males, gender differences regarding normative treatment need might result from an uneven distribution of orthodontic treatment between the genders.

Conclusions

Significant negative, but weak correlations were found between Turkish university students' awareness of

malocclusion and satisfaction with personal dental appearance at the various severity levels of malocclusion. The findings of this study showed that age had a significant effect on satisfaction and gender on DAI score variation. No significant gender differences were found in relation to either the subject's awareness or satisfaction. Females had a greater need for normative treatment except in the 20- to 22-year-old group, and satisfaction decreased with age.

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References

- Adams G R 1997 Physical attractiveness research: toward a developmental psychology of beauty. Human Development 20: 217–239
- Albino J E, Cunat J J, Fox R N, Lewis E A, Slakter M J, Tedesco L A 1981 Variables determining individuals who seek orthodontic treatment. Journal of Dental Research 60: 1661–1667
- Albino J E, Lewis E A, Wu T H, Slakter M J, Fox R N 1979 Comparison of professional and public assessment of malocclusion. Journal of Dental Research 58: 136 (Abstract)
- Altun C, Güven G, Başak F, Akbulut E 2005 Evaluation of children in the group of 6 to 11 with respect to oral-dental health. Gülhane Military Medical Journal 47: 114–118
- Bergström K, Halling A, Huggare J 1998 Orthodontic treatment demanddifferences between urban and rural areas. Community Dental Health 15: 272–276
- Berscheid E 1980 An overview of the psychological effects of physical attractiveness. In: Lucker G W, Ribbens K A, McNamara J A (eds). Psychological aspects of facial form. Monograph No. 11, Craniofacial Growth Series Center for Human Growth and Development University of Michigan, Ann Arbor, pp. 1–23
- Birkeland K, Bøe O E, Wisth P J 1996 Orthodontic concern among 11-yearold children and their parents compared with orthodontic treatment need

assessed by Index of Orthodontic Treatment Need. American Journal of Orthodontics and Dentofacial Orthopedics 110: 197–205

- Brisman A S 1980 Esthetics: a comparison of dentists' and patients' concepts. Journal of the American Dental Association, 100: 345–352
- Burden D J, Mitropoulos C M, Shaw W C 1994 Residual orthodontic treatment need in a sample of 15- and 16-year-olds. British Dental Journal 176: 220–224
- Cons N C, Jenny J, Kohout F J 1987 Associations of dental aesthetics (DAI) with dental appearance, smile and desire for orthodontic treatment. Journal of Dental Research 66: 1081 (Abstract)
- Esa R, Razak I A, Allister J H 2001 Epidemiology of malocclusion and orthodontic treatment need of 12-13-year-old Malaysian schoolchildren. Community Dental Health 18: 31–36
- Espeland L V 1993 An appraisal of non-professional perspectives on occlusal anomalies and orthodontic care. Thesis, University of Oslo.
- Fox R N, Albino J E, Green L J, Jones G, Jones M 1982 Development and validation of a measure of attitudes towards malocclusion. Journal of Dental Research 61: 1039–1043
- Gosney M B E 1986 An investigation into some of the factors influencing the desire for orthodontic treatment. British Journal of Orthodontics 13: 87–94
- Grainger R M 1967 Orthodontic treatment priority index. PHS publication no. 1000, Series 2, No. 25. US Government Printing Office, Washington
- Helm S 1968 Malocclusion in Danish children with adolescent dentition. An epidemiologic study. American Journal of Orthodontics 54: 352–366
- Holmes A 1992 The subjective need and demand for orthodontic treatment. British Journal of Orthodontics 19: 287–297
- Jenny J 1975 A social perspective on need and demand for orthodontic treatment. International Dental Journal 25: 248–256
- Jenny J, Cons N C 1996a Comparing and contrasting two orthodontic indices, the Index of Orthodontic Treatment Need and the Dental Aesthetic Index. American Journal of Orthodontics and Dentofacial Orthopedics 110: 410–416
- Jenny J, Cons N C 1996b Establishing malocclusion severity levels on the dental aesthetic index (DAI) scale. Australian Dental Journal 41: 43–46
- Jenny J, Proshek J M 1986 Visibility and prestige of occupations and the importance of dental appearance. Journal of the Canadian Dental Association 52: 987–989
- Kerosuo H, Kerosuo E, Niemi M, Simola H 2000 The need for treatment and satisfaction with dental appearance among young Finnish adults with and without a history of orthodontic treatment. Journal of Orofacial Orthopedics 61: 330–340
- Lewis E A, Albino J E, Cunnat J J, Tedesco L A 1982 Reliability and validity of clinical assessments of malocclusion. American Journal of Orthodontics 81: 473–477
- Linn E L 1966 Social meaning of dental appearance. Journal of Health and Human Behavior 7: 289–295
- Lucker G W, Graber L W 1978 Perceptions of dental attractiveness and friend selection in school children. American Journal of Orthodontics 74: 686–687
- Mechanic D 1974 Ideology and medical technology and health care organizations in modern nations. American Journal of Public Health 65: 241–247
- Onyeaso C O 2002 An assessment of relationship between self-esteem, orthodontic concern, and Dental Aesthetic Index (DAI) scores among secondary school students in Ibadan, Nigeria. International Dental Journal 53: 79–84
- Onyeaso C O 2003 Orthodontic concern of parents compared with orthodontic treatment need assessed by the Dental Aesthetic Index (DAI) in Ibadan, Nigeria. Odonto Stomatologie Tropicale 101: 13–20
- Onyeaso C O, Aderinokun G A 2003 The relationship between dental aesthetic index (DAI) and perception of aesthetics, function and speech

amongst secondary school children in Ibadan, Nigeria. International Journal Paediatric Dentistry 13: 336-341

- Onyeaso C O, Sanu O O 2005 Perception of personal dental appearance in Nigerian adolescents. American Journal of Orthodontics and Dentofacial Orthopedics 127: 700–707
- Otuyemi O D, Noar J H 1996a A comparison between DAI and SCAN in estimating orthodontic treatment need. International Dental Journal 46: 35–40
- Otuyemi O D, Noar J H 1996b Variability in recording and grading the need for orthodontic treatment using the HMAR, OI and DAI. Community Dentistry and Oral Epidemiology 24: 222–224
- Prahl-Andersen B, Boersma H, Van der Linden F P G M, Moore A W 1979 Perceptions of dentofacial morphology by lay persons, general dentists and orthodontists. Journal of the American Dental Association 98: 209–212
- Salzmann J A 1968 Handicapping malocclusion assessment to establish treatment priority. American Journal of Orthodontics 54: 749–765
- Samuels J, Proshek J 1973 The importance of dental appearance in a prestige hierarchy of occupations. Journal of Dental Research 52: 118–122 (Abstract)
- Shaw W C 1981 Factors influencing the desire for orthodontic treatment. European Journal of Orthodontics 3: 151–162
- Shaw W C, Lewis H G, Robertson N R E 1975 Perception of malocclusion. British Dental Journal 138: 211–216
- Shaw W C, O'Brien K D, Richmond S 1991 Quality control in orthodontics: factors influencing the receipt of orthodontic treatment. British Dental Journal 19: 66–68
- Sheats R D, McGorray S P, Keeling S D, Wheeler T T, King G J 1998 Occlusal traits and perception of orthodontic need in eighth grade students. Angle Orthodontist 68: 107–114
- Spencer A J, Allister J H, Brennan D S 1992 Utility of the dental aesthetic index as an orthodontic screening tool in Australia. Thesis, University of Adelaide
- Strauss R P 1980 Surgery, activism and aesthetics: a sociological perspective on treating facial disfigurement. In: Lucker G W, McNamara J A (eds). Psychological aspects of facial form. Monograph No. 11, Craniofacial Growth Series Center for Human Growth and Development University of Michigan, Ann Arbor, pp. 157–215
- Summers C J 1971 The occlusal index: a system for identifying and scoring occlusal disorders. American Journal of Orthodontics 59: 552–567
- Tang E L K, So L L Y 1995 Correlation of orthodontic treatment demand with treatment need assessed using two indices. Angle Orthodontist 65: 443–450
- Tedesco L A, Albino J E, Cunat J J, Green L J, Lewis E A, Slakter M J 1983 A dental-facial attractiveness scale: part I. Reliability and validity. American Journal of Orthodontics 83: 38–43
- Tuominen M L, Nyström M, Tuominen R J 1995 Subjective and objective orthodontic treatment need among orthodontically treated and untreated Finnish adolescents. Community Dentistry and Oral Epidemiology 23: 286–290
- Tuominen M L, Tuominen R J, Nyström M E 1994 Subjective orthodontic treatment need and perceived dental appearance among young Finnish adults with and without previous orthodontic treatment. Community Dental Health 11: 29–33
- World Health Organization 1989 International collaboration study of oral health outcomes (ICS II), document 2: oral data collection and examination criteria. WHO, Geneva
- World Health Organization 1997 Oral health surveys: basic methods, 4th edn., WHO, Geneva, pp. 47–52
- Yeh M, Koochek A, Vlaskalic V, Boyd R, Richmond S 2000 The relationship of 2 professional and occlusal indexes with patients' perceptions of aesthetics, function, speech, and orthodontic treatment need. American Journal of Orthodontics and Dentofacial Orthopedics 118: 421–428

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