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Perception of orthodontic treatment need in children and adolescents

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SUMMARY Patients' and parents' perception of malocclusion are important in determining orthodontic treatment demand, motivation, and cooperation. The aim of this study was to investigate differences in perception of treatment need in currently orthodontically treated, previously treated, and untreated subjects.

The sample comprised 3196 children and adolescents (1593 males and 1603 females) aged 8–19 years (mean age 13.0±3.6 years) from 24 randomly selected public schools in Zagreb, Croatia. Objective treatment need was assessed clinically using the Dental Aesthetic Index (DAI). Subjective treatment need was estimated separately by an orthodontic resident, the child/adolescent and his/her parent using the Standardized Continuum of Aesthetic Need (SCAN) procedure. The children/adolescents completed a questionnaire that had five questions with five-point Likert-type scale answers concerning satisfaction with dental appearance, importance of teeth for facial appearance, and malocclusion-related quality of life. Spearman correlation and logistic regression were used for statistical analysis.

Associations between objective and subjective orthodontic treatment need were weak but statistically significant (Rho from 0.20 to 0.50; $P<0.05$). Malocclusion-related quality of life was poorly associated with treatment need. Satisfaction with tooth appearance showed the most frequent statistically significant correlation (Rho from –0.14 to –0.35; $P<0.05$), while importance of aligned teeth for facial appearance and social contacts had the weakest correlation with treatment need. Perception of treatment need was greater in previously treated subjects. Parents' perception had a low predictive value.

The findings of this study show that malocclusion has more impact on emotional well-being than on function or social contacts.

Introduction

Traditional occlusal indices define orthodontic treatment need from a clinician's point of view, but often no consideration is given to the concepts of perceptual, functional, and social needs (Hamdan, 2004). Recently there has been increasing interest in relating occlusal indices to individual perceptions of orthodontic treatment need and quality of life (Yeh *et al.*, 2000; Cunningham and Hunt, 2001; Onyeaso and Aderinokun, 2003; Kok *et al.*, 2004; Abu Alhaija *et al.*, 2005; Klages *et al.*, 2006; Bernabé *et al.*, 2008). The importance of oral health-related quality of life (OHRQoL) is relevant for children and adolescents since it may affect their psychological development and social skills (Nobile *et al.*, 2007). Gender, age, socio-economic background, self-esteem, and peer group norms have been suggested as factors affecting the self-perception of dental appearance, malocclusion, and the uptake of orthodontic treatment (Jenkins *et al.*, 1984; Shaw *et al.*, 1991; Burden, 1995; Mandall *et al.*, 2001; Abu Alhaija *et al.*, 2005). Previous orthodontic experience could also be a factor influencing perception of treatment need (Birkeland *et al.*, 2000; Kerosuo *et al.*, 2000). Decisions to provide and accept orthodontic treatment are not defined only by orthodontists, but are arrived at by negotiation between interested parties—the child, parents, dentist, orthodontist, and payment agency (Shaw, 1981). Patients' and parents' perception of malocclusion cannot be underestimated. The patient's self-perception is of considerable importance in determining treatment demand and co-operation, while parents are the most powerful single factor in the motivation for treatment (Shaw, 1981; Lewit and Virolainen, 1986).

Several studies have investigated the relationship between objective orthodontic treatment need and subjective patient and parent perceptions of malocclusion (Shaw, 1981; Burden and Pine, 1995; Pietilä and Pietilä, 1996; Mandall *et al.*, 1999; Birkeland *et al.*, 2000; Yeh *et al.*, 2000; Hamdan, 2004; Abu Alhaija *et al.*, 2005; Nobile *et al.*, 2007). Data concerning self-perception of orthodontic treatment need are available, but there is no evidence on differences in perception between currently orthodontically treated, previously treated, and untreated children and young adults.

Therefore, the purpose of this study was to investigate differences in perception of orthodontic treatment need in these three groups of subjects. Special attention was given to psychosocial factors influencing the demand for orthodontic treatment. These included: satisfaction with dental appearance, importance of teeth for facial

appearance, and malocclusion-related quality of life (manifested in difficulties with speech, laughing without embarrassment, and interacting with other people). A further aim was to determine the strength of the correlation between clinicians', children's/adolescents' and parents' perceptions of treatment need.

Subjects and methods

The study protocol was approved by the Croatian Ministry of Science, Education and Sports, the Ministry of Health and Social Affairs, and the Ethics Committee of the Zagreb University School of Dental Medicine. Written parent informed consent was also obtained for dental examinations and interviews/questionnaires.

Data were collected during an epidemiological survey in the period September 2006 to February 2007 of 3196 children and adolescents (1593 males and 1603 females) aged 8–19 years (mean age 13.0 ± 3.6 years) randomly selected using a one-stage cluster sampling procedure in 24 public schools in Zagreb, Croatia (12 elementary and 12 secondary, Table 1). Three elementary schools were randomly selected from each of the four administrative sections of the city of Zagreb and the four secondary schools from each of three types of schools (general, technical, and crafts) regardless of location. According to the 2001 census (Drzavni zavod za statistiku, 2006), there were around 8800 subjects in each age group (range 8089–10 118). Thus, the investigated sample included approximately 10 per cent of that population.

A fieldwork team of four previously trained and calibrated examiners performed the intra-oral examinations using the World Health Organization's (WHO) manual probe (WHO, 1997), a mouth mirror, and an artificial light placed on the examiner's head. The training and calibration of the examiners involved a 2-day duration workshop, including theoretical and practical aspects of the indices to be used. The calibration procedures were planned in order to simulate the conditions that the investigators would find in the field. Professional treatment need was assessed using the Dental Aesthetic Index (DAI) according to the WHO (1997) guidelines. In children in the mixed dentition, DAI scoring was modified (Johnson *et al.*, 2000).

Subjective aesthetic treatment need, based on the appearance of the anterior teeth, was estimated separately for each subject by an orthodontic resident (SV), the child and his/her parents using the 10-point visual scale of the Standardized Continuum of Aesthetic Need (SCAN), also known as the Aesthetic Component of Index of Orthodontic Treatment Need (Evans and Shaw, 1987). The scale is illustrated by a series of photographs rated for overall dental attractiveness, with grade 1 representing the most attractive and grade 10 the least attractive. The children and adolescents completed a five-section questionnaire concerning satisfaction with the appearance of their teeth, the importance of teeth for facial appearance, and malocclusion-related quality of life (difficulties in speech, laughing without embarrassment, and contacts with other people). Satisfaction and importance were scored using a five-point Likert-type scale with the end points 'very dissatisfied' (1) and 'very satisfied' (5) for satisfaction and 'completely unimportant' (1) and 'completely important' (5) for importance. Frequency of difficulties during speaking, laughing, and social contacts was also scored using a five-point Likert-type scale as follows: 'never' (1), 'rarely' (2), 'monthly' (3), 'weekly' (4), and 'daily' (5). For logistic regression analysis, dummy variables were constructed yielding the categories 'dissatisfied' (0) and 'satisfied' (1) with respect to satisfaction with teeth appearance and 'unimportant' (0) and 'important' (1) for importance of aligned teeth for facial appearance. Frequency of occurrence

Table 1 The sample population according to age group and gender.

Age group (years)	Gender	Orthodontic treatment			Total
		Never treated	Orthodontically treated	Currently being treated	
9	Male	481	10	15	506
	Female	300	3	30	333
	Total	781	13	45	839
12	Male	359	56	78	493
	Female	339	63	114	516
	Total	698	119	192	1009
15	Male	245	61	26	332
	Female	228	69	84	381
	Total	473	130	110	713
18	Male	163	77	22	262
	Female	190	112	71	373
	Total	353	189	93	635
Total males		1248 (78.3%)	204 (12.8%)	141 (8.9%)	1593
Total females		1057 (65.9%)	247 (15.4%)	299 (18.7%)	1603
Total sample		2305 (72.1%)	451 (14.1%)	440 (13.8%)	3196

of difficulties in speech, laughing without embarrassment, and contacts with other people was also dichotomized: 'never/rarely' (0) and 'monthly/weekly/daily' (1).

All data were analyzed using the SAS 9.0 and Statistica 7.1 statistical software (SAS Institute Inc., Cary, North Carolina, USA and StatSoft Inc., Tulsa, Oklahoma, USA, respectively). Non-parametric Spearman rank correlation was used to explore the relationship between perception of treatment need, clinically assessed need, and related factors in the three groups of subjects. Using the Fisher *r*-to-*z* transformation, a value of *z* was applied to assess the significance of the difference between correlation coefficients of untreated, previously treated, and currently treated subjects. Associations between factors influencing perception of orthodontic treatment need were estimated by multiple regression using the logit model with 95 per cent confidence intervals given for the odds ratios, indicating statistically significant relationships if both values were either greater or less than 1. The backward conditional method of binary logistic regression was used to select variables to fit the criteria for multiple logistic regression. The significance of the effects in the model was performed via Wald statistics and likelihood-ratio test with chi-square statistics. An alpha level of 0.05 was considered statistically significant.

Results

The dropout rate in the initial sample of 3337 children and adolescents was 4.2 per cent, so the final sample comprised 3196 children and adolescents. Inter- and intra-examiner reliabilities were evaluated by means of repeated measurements on 10 subjects, with age similar to the sample, with a 7-day interval from the first examination. The agreement proportion of over 83 per cent and weighted Kappa score of over 0.64 indicated significant reproducibility and substantial agreement (Table 2).

Prevalence and severity of malocclusions assessed by the DAI in the groups of untreated, previously orthodontically treated, and currently treated subjects are shown in Figure 1. Associations between clinical and aesthetic assessments of orthodontic treatment need were weak but statistically significant (Table 3, $P<0.05$). Correlation was stronger in previously treated subjects. The association was similar for both males and females. The greatest disagreement in aesthetic assessment using the SCAN was evident between parents and children/adolescents. Malocclusion-related quality of life, expressed as difficulties with speech, laughing without embarrassment, and contact with other people, was poorly associated with clinically and aesthetically assessed treatment need. The importance of teeth for facial appearance also had a poor relationship with severity of malocclusion and orthodontic treatment need. Satisfaction with dental appearance showed the most frequent statistically significant correlation (Spearman Rho from −0.14 to −0.35; Figures 2 and 3), and importance of aligned teeth for facial appearance and contacts with other people the weakest correlation with treatment need. Untreated subjects were most satisfied with their dental appearance, regardless of treatment need, but satisfaction–malocclusion correlation was significantly stronger in previously treated subjects than in those untreated or currently treated (Table 3, $P<0.05$). Parents' aesthetic assessment of their children's/adolescent's treatment need had the lowest predictive value for all variables concerning the satisfaction of children/adolescents with their dental appearance, importance of teeth for facial appearance, and malocclusion-related quality of life. Associations between orthodontic history and factors influencing the demand for orthodontic treatment are shown in Table 4. Untreated subjects in relation to those previously treated were younger,

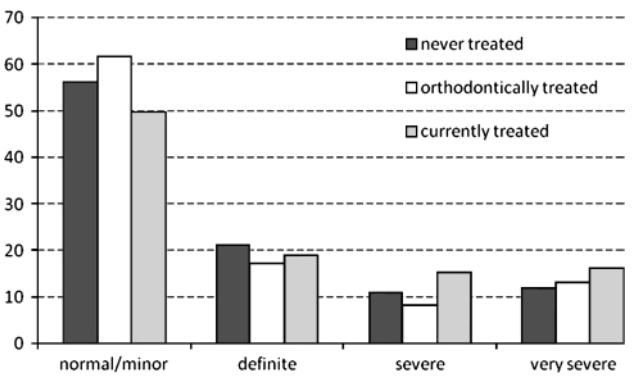

Figure 1 Prevalence of malocclusions in the groups of untreated, previously orthodontically treated, and currently treated subjects.

Table 2 Inter- and intra-examiner reliability scores for all examiners assessed by Cohen Kappa test.

	Examiner 1	Examiner 2	Examiner 3	Examiner 4	Examiner 5
Examiner 1	0.815*	0.795	0.953	0.820	0.825
Examiner 2	0.795	0.838*	0.852	0.716	0.856
Examiner 3	0.953	0.852	0.821*	0.773	0.640
Examiner 4	0.820	0.716	0.773	0.862*	0.642
Examiner 5	0.825	0.856	0.640	0.642	0.899*

*Intra-examiner reliability evaluated with a 7-day interval from the first examination.

Table 3 Correlation of subjective and objective assessment of orthodontic treatment need using Spearman correlation.

	Treatment	DAI	SCAN O	SCAN C	SCAN P
DAI	NT		0.474**	0.265**	0.325**
	T		0.497**	0.309**	0.190 NS
	IT		0.383**	0.200**	0.456*
SCAN O	NT	0.474**		0.446**	0.411**
	T	0.497**		0.528**	−0.037 NS
	IT	0.383**		0.537**	0.450**
SCAN C	NT	0.265**	0.446**		0.280**
	T	0.309**	0.528**		0.845**
	IT	0.200**	0.537**		0.726**
SCAN P	NT	0.325**	0.411**	0.280**	
	T	0.190 NS	−0.037 NS	0.845**	
	IT	0.456*	0.450**	0.726**	
Satisfaction	NT	−0.182**	−0.196**	−0.241**	−0.113 NS
	T	−0.295**	−0.350**	−0.336**	−0.113 NS
	IT	−0.138*	−0.191**	−0.255**	−0.137 NS
Importance	NT	−0.04 NS	−0.067*	−0.111**	0.097 NS
	T	−0.014 NS	−0.070 NS	−0.033 NS	0.223 NS
	IT	0.057 NS	−0.078 NS	−0.023 NS	0.212 NS
Speech	NT	0.119**	0.126**	0.041 NS	−0.046 NS
	T	−0.016 NS	0.004 NS	0.005 NS	−0.317 NS
	IT	−0.003 NS	0.179**	0.123*	−0.108 NS
Laughing	NT	0.097*	0.127**	0.102**	−0.149 NS
	T	0.021 NS	0.084 NS	0.152**	0.334 NS
	IT	0.113 NS	0.144*	0.125*	−0.055 NS
Contacts	NT	0.04 NS	0.093*	0.018 NS	−0.040 NS
	T	0.034 NS	0.075 NS	0.110*	−0.317 NS
	IT	0.02 NS	−0.018 NS	0.027 NS	−0.139 NS

Brackets represent significant differences between correlation coefficients. DAI, Dental Aesthetic Index; SCAN, Standardized Continuum of Aesthetic Need; SCAN O, assessment by orthodontist; SCAN C, assessment by child; SCAN P, assessment by parent; NT, never treated subjects; T, previously treated; IT, currently in treatment.
*$P < 0.05$; **$P < 0.01$ (two tailed).

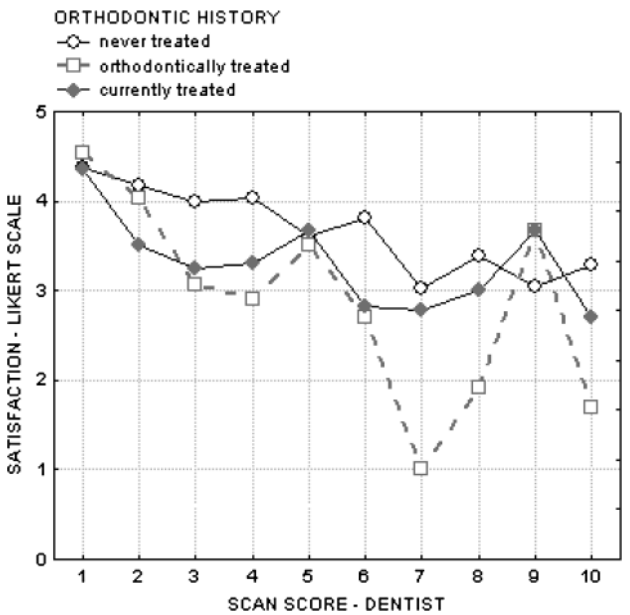

Figure 2 Association between treatment need (Standard Continuum of Aesthetic Need, SCAN) assessed by the clinician.

more satisfied with dental appearance, and had a lower objective treatment need. In relation to subjects in active orthodontic treatment during the study, untreated subjects often males, were more satisfied and had a lower objective treatment need. Previously treated children and adolescents in relation to currently treated subjects were mainly older males who less frequently had problems with laughing due to malocclusion and had a lower objective treatment need. Associations between satisfaction with dental appearance, importance of aligned teeth for facial appearance, and OHRQoL with orthodontic treatment need are listed in Table 5. Younger untreated boys with lower objective and subjective treatment needs were more satisfied with their dental appearance. Teeth were more important for younger girls with lower self-perceived orthodontic treatment need. Laughing without embarrassment was a more frequent problem in older currently treated girls with a higher objective and self-perceived treatment need. Problems in interacting with other people were more pronounced in younger children and adolescents with a higher subjective treatment need.

Discussion

Associations between clinical and aesthetic assessments of orthodontic treatment need, as well as between treatment needs and OHRQoL, were mainly weak, often with stronger correlations in subjects with an orthodontic history.

Several studies have also shown a discrepancy between an individual's own view of the acceptability of his/her dental appearance and the views of dental assessors (Shaw, 1981; Abu Alhaija *et al.*, 2005; Alkhatib *et al.*, 2005). Not only can objective and subjective treatment needs differ, but there is also a moderate correlation between different self-assessment visual scales (Flores–Mir *et al.*, 2004). It seems that perceptions of dental aesthetics and orthodontic treatment need are very similar in different races and ethnic groups (Otuyemi *et al.*, 1998; Alkhatib *et al.*, 2005). The present results indicate moderate correlation between a clinician's objective (DAI) and subjective (SCAN) assessment (Rho = 0.4–0.5) and a weak correlation between a clinician's objective and the children's and parents' subjective assessment (Rho = 0.2–0.3 and 0.2–0.5, respectively). There is some evidence that the majority of children and parents fail to accurately describe the anterior occlusal characteristics (Shaw, 1981). It seems that the association is weakest between parents and professionals in assessment of treatment needs of previously treated children and adolescents (Rho < 0.2). Although the children's and parents' perception of malocclusion severity is of considerable importance in determining treatment demand, the data showed a weak correlation between their perceptions and clinically assessed needs, but very good agreement between parents and children in subjective assessment of previously treated and currently treated subjects (Rho = 0.7–0.9). Difference between the parents' and clinician's perception could be explained by parents' overscoring treatment need due to a sense of obligation to provide the best care for their children (Hamdan, 2004). Although parents play an important role in the motivation of children for treatment and often make the final decision about treatment, according to the data, they had the lowest predictive value concerning children's satisfaction with dental appearance, importance of teeth for facial appearance, and their malocclusion-related quality of life.

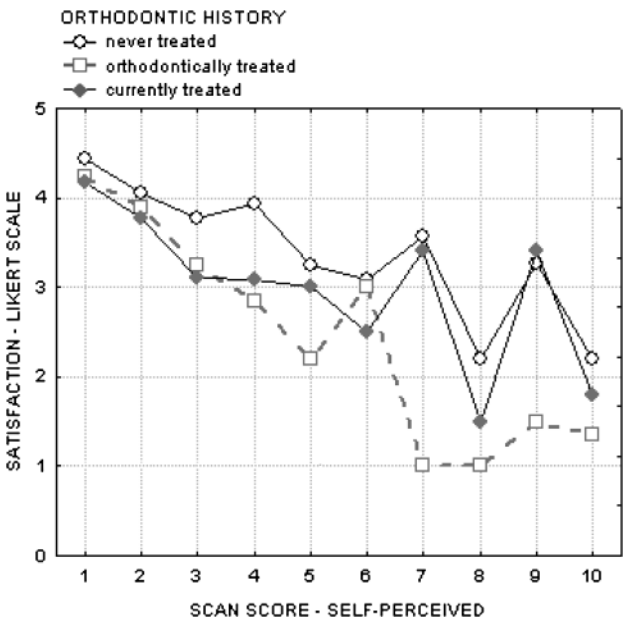

Figure 3 Association between self-perceived treatment need (Standard Continuum of Aesthetic Need, SCAN) and the child's satisfaction with their own dental appearance.

Differences not only exist in perception of treatment need between untreated, previously treated and currently treated patients, but certain variations can be found even between orthodontists and dentists worldwide. These differences are basically related to the practitioner's country of origin and method of remuneration (Richmond *et al.*,

Table 4 Associations between orthodontic treatment history and factors influencing the demand for orthodontic treatment as estimated by the multiple logistic regression models.

Dependent variable	Independent variable	Logistic coefficient	Standard error	Wald test significance	Odds ratio	95% Confidence interval
Never treated (1) versus previously treated (0)*	Age	−0.327	0.024	<0.001	0.721	0.688–0.756
	DAI score	−0.018	0.008	0.016	0.982	0.967–0.997
	Satisfaction	0.210	0.070	0.003	1.233	1.074–1.416
Never treated (1) versus currently treated (0)**	DAI score	−0.032	0.008	<0.001	0.969	0.954–0.984
	Satisfaction	0.314	0.073	<0.001	1.369	1.186–1.581
	SCAN dentist	0.155	0.037	<0.001	1.167	1.085–1.255
	Gender—male	0.949	0.138	<0.001	2.583	1.970–3.386
Previously treated (1) versus currently treated (0)***	DAI score	−0.034	0.010	0.001	0.966	0.947–0.986
	SCAN dentist	0.156	0.055	0.005	1.169	1.049–1.302
	Age	0.231	0.051	0.000	1.259	1.140–1.391
	Laughing	−0.208	0.094	0.026	0.812	0.676–0.976
	Gender—male	0.604	0.183	0.001	1.830	1.279–2.618

Only statistically significant variables are listed. DAI, Dental Aesthetic Index; SCAN, Standardized Continuum of Aesthetic Need.
*R^2 = 0.135; **R^2 = 0.051; ***R^2 = 0.080 (Cox and Snell Pseudo *R*-square).

Table 5 Associations between satisfaction with dental appearance (0 = dissatisfied, 1 = satisfied), importance of aligned teeth for facial appearance (0 = unimportant, 1 = important), difficulties in speech, laughing without embarrassment, and social contacts (0 = never/rarely, 1 = monthly/weekly/daily) and orthodontic treatment needs considering the effect of gender (0 = girls, 1= boys) as estimated by multiple logistic regression models.

Dependent variable	Independent variable	Logistic coefficient	Standard error	Wald test significance	Odds ratio	95% Confidence interval
Satisfaction*	Age	−0.132	0.017	<0.001	0.877	0.848–0.906
	Gender—male	0.564	0.109	<0.001	1.758	1.419–2.177
	DAI score	−0.034	0.007	<0.001	0.967	0.955–0.979
	SCAN child	−0.232	0.031	<0.001	0.793	0.747–0.843
	SCAN orthodontist	−0.174	0.031	<0.001	0.840	0.791–0.893
	Untreated subjects	0.395	0.155	0.011	1.484	1.096–2.010
Importance**	Age	−0.036	0.012	0.003	0.964	0.941–0.988
	Gender—male	−0.787	0.094	<0.001	0.455	0.379–0.547
	SCAN child	−0.084	0.024	<0.001	0.920	0.878–0.964
Laughing***	Age	0.155	0.047	0.001	1.167	1.065–1.279
	Gender—male	−0.405	0.182	0.026	0.667	0.466–0.953
	DAI score	0.022	0.010	0.027	1.022	1.002–1.042
	SCAN child	0.164	0.049	0.001	1.178	1.069–1.298
	Untreated subjects	−0.529	0.219	0.016	0.589	0.383–0.905
	Previously treated subjects	−0.585	0.265	0.027	0.557	0.332–0.936
Contacts****	Age	−0.221	0.045	<0.001	0.802	0.735–0.875
	SCAN orthodontist	0.243	0.054	<0.001	1.276	1.148–1.418

Only statistically significant variables are listed. DAI, Dental Aesthetic Index; SCAN, Standardized Continuum of Aesthetic Need.
*R^2 = 0.131; **R^2 = 0.034; ***R^2 = 0.028; ****R^2 = 0.027 (Cox and Snell Pseudo *R*-square).

1994; Richmond and Daniels, 1998; Grzywacz, 2004). There is also a tendency for dental attractiveness to be scored higher and orthodontic treatment need lower when assessing facial photographs than study models (Sherlock *et al.*, 2008). Poor dental aesthetics is the main motivating factor for undertaking orthodontic therapy, but the demand for treatment often exceeds objective need (Grzywacz, 2004). However, it is likely that perceived treatment need tends to be similar within the same interest groups. Contrary to the clear differences in lay people, Berk *et al.* (2002) found a high level of agreement on treatment need between dental practitioners—general dentists, orthodontists, and paediatric dentists. The treatment decisions by orthodontists could be predicted with an accuracy of over 80 per cent in scoring aesthetics, upper arch crowding, crossbite, overbite, and sagittal molar relationship (Richmond and Daniels, 1998). Orthodontists and general dentists, as treatment providers, appear to be more restrictive, consistent, and reliable in their judgement of orthodontic treatment need than both orthodontically treated and untreated subjects (Petersen and Dahlström, 1998). Prospective orthodontic patients and those previously treated rated treatment need in a very similar way among themselves, but had a more positive perception towards treatment (Petersen and Dahlström, 1998).

Malocclusion-related quality of life, expressed in terms of difficulties with speech, laughing without embarrassment, and social contacts, was poorly associated with clinically and aesthetically assessed treatment need. Some studies also found low or near zero correlation between higher normative orthodontic treatment need and a lower OHRQoL (Onyeaso and Aderinokun, 2003; Kok *et al.*, 2004). Satisfaction with dental appearance in the present study was also poorly related to treatment need but usually had a statistically significant correlation (Spearman Rho from −0.14 to −0.35), while the importance of aligned teeth for facial appearance and contacts with other people had the weakest correlation with treatment need. Katz (1978) failed to find a meaningful association between a subject's levels of satisfaction with dental appearance and any orthodontic indices. The satisfaction–malocclusion correlation in the present study was significantly higher in previously treated subjects than in those both never treated and currently treated.

Perceptions of orthodontic treatment need are multifactorial and influenced to a greater or lesser degree by many factors. In fact, 50 per cent of the demand for orthodontic treatment is not related to measurable malocclusions (Lilja-Karlander *et al.*, 2003). It seems that satisfaction with dental appearance and perception of treatment need is affected by age, gender, and urban/rural areas of living. This can be explained by the greater dental awareness and attractiveness concerns of older, female, and urban populations (Roberts *et al.*, 1989; Pietilä and Pietilä, 1996; Abu Alhaija *et al.*, 2005; Peres *et al.*, 2008). Some other investigations, including the current research, did not identify gender as an influencing factor (Burden and Pine, 1995; Flores–Mir *et al.*, 2004). Children's self-esteem appears to be related to their self-perceived malocclusion and its psychosocial impact (Mandall *et al.*, 2001). Teasing experiences and bullying at school may play a role in the

self-perception of malocclusion and uptake of orthodontic treatment (Shaw, 1981; Mandall *et al.*, 1999; Di Biase and Sandler, 2001; Hamdan, 2004).

There is some evidence that the majority of young adults are satisfied with their dental appearance regardless of various degrees of objective treatment need (Kerosuo *et al.*, 2000; Lilja-Karlander *et al.*, 2003). Kerosuo *et al.* (2000) calculated that the odds ratio of being satisfied with dental appearance was three times higher in orthodontically treated subjects. Untreated subjects in the present investigation showed the best satisfaction scores but their malocclusion–satisfaction correlation was low. Twenty per cent, on average, of orthodontically treated patients showed no change or even a worsening in DAI scores with treatment (Lobb *et al.*, 1994), while results of present investigation show that the malocclusion–satisfaction correlation was stronger in previously treated patients. They may be the most competent group to judge the relationship between their previous malocclusion and an individual functional-occlusal optimum achieved by therapy.

Conclusions

Associations between clinical and aesthetic assessments of orthodontic treatment need are weak and poorly related to quality of life. The findings of the present investigation support the view that malocclusion has more impact on emotional well-being than on function or social contacts. Perception of orthodontic treatment need is greater in previously treated subjects, while parents' perception has a low predictive value.

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