Review Article

The Impact of Malocclusion/Orthodontic Treatment Need on the Quality of Life

A Systematic Review

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ABSTRACT

Objective: To assess the current evidence of the relationship between malocclusion/orthodontic treatment need and quality of life (QoL).

Materials and Methods: Four electronic databases were searched for articles concerning the impact of malocclusion/orthodontic treatment need on QoL published between January 1960 and December 2007. Electronic searches were supplemented by manual searches and reference linkages. Eligible literature was reviewed and assessed by methodologic quality as well as by analytic results.

Results: From 143 reviewed articles, 23 met the inclusion criteria and used standardized health-related QoL (HRQoL) and orthodontic assessment measures. The majority of studies (18/23) were conducted among child/adolescent populations. Seventeen of the papers were categorized as level 1 or 2 evidence based on the criteria of the Oxford Centre for Evidence-Based Medicine. An observed association between HRQoL and malocclusion/orthodontic treatment need was generally detected irrespective of how they were assessed. However, the strength of the association could be described as modest at best. Key findings and future research considerations are described in the review.

Conclusions: Findings of this review suggest that there is an association (albeit modest) between malocclusion/orthodontic treatment need and QoL. There is a need for further studies of their relationship, particularly studies that employ standardized assessment methods so that outcomes are uniform and thus amenable to meta-analysis. (*Angle Orthod.* 2009;79:585–591.)

KEY WORDS: Malocclusion; Orthodontic treatment need; Quality of life, Oral health–related quality of life

INTRODUCTION

Although malocclusion in itself is neither a disease nor a life-threatening condition, there has long been a marked demand for orthodontic care.[1,2] Moreover, the treatment of malocclusion places a considerable burden on health care resources globally, particularly when funded by public means.[3] In an attempt to prioritize the treatment of malocclusion, various occlusal indices have been developed based on the severity of malocclusion and/or the conceivable destruction it may cause to oral health if left untreated.[4–7] However, it has long been recognized that perhaps people seek and undergo orthodontic treatment not because of the anatomic irregularities per se or to prevent the destruction of tissue within the oral cavity, but because of the consequences of the esthetic impairment caused by malocclusion.[8] Thus, malocclusion and orthodontic care have become a quality-of-life (QoL) issue.

QoL is a vague and abstract concept with usages across many disciplines and in essence reflects an individual's experiences that influence one's satisfaction with life.[9] The term *health-related quality of life*

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Table 1. Summary of Studies: Study Design, Sample, Occlusal Indices and Quality-of-Life (QoL) Instruments (n = 23)

Authors and Year	Study Design	Sample Source	Sample Type	Sample Size	Age of Sample	QoL Instruments[a]
Do and Spencer, 2007[15]	Cross-sectional	Community	Randomized	667	8–13 y	CPQ_{11-14}
Locker, 2007[16]	Cross-sectional	Community	Randomized	370	11–14 y	CPQ_{11-14}
O'Brien et al, 2007[17]	Cross-sectional	Convenient	Nonrandomized	147	11–14 y	CPQ_{11-14}
Dunlow et al, 2007[18]	Cross-sectional	Convenient	Consecutive	124	9–11 y	COHIP
Shaw et al, 2007[19]	Longitudinal	Community	Nonrandomized	1018	11–12 y	WHOQOL-BREF, SF-36, psychologic scales (1)
Locker et al, 2007[20]	Cross-sectional	Convenient	Consecutive	141	11–14 y	CPQ_{11-14}
Tajima et al, 2007[21]	Cross-sectional	Convenient	Consecutive	193	Adult	SF-36, SOHSI, orthognathic quality of life questionnaire
Traebert and Peres, 2007[22]	Cross-sectional	Community	Consecutive	414	18 y	OIDP
Kenealy et al, 2007[23]	Longitudinal	Community	Nonrandomized	1018	11–12 y	WHOQOL-BREF, SF-36, psychologic scales
Johal et al, 2007[24]	Cross-sectional	Convenient	Consecutive	90	13–15 y	CPQ_{11-14}
Tsakos et al, 2006[25]	Cross-sectional	Community	Nonrandomized	1126	11–12 y	Child-OIDP
O'Brien et al, 2006[26]	Longitudinal	Community	Randomized	325	11–12 y	CPQ_{11-14}
Marques et al, 2006[27]	Cross-sectional	Community	Randomized	333	10–14 y	OIDP
Traebert and Peres, 2005[28]	Cross-sectional	Community	Randomized	414	18 y	OIDP
Klages et al, 2006[29]	Cross-sectional	Community	Nonrandomized	194	18–30 y	PIDAQ
Foster et al, 2005[30]	Cross-sectional	Community	Randomized	600	12–13 y	CPQ_{11-14}
Marshman et al, 2005[31]	Cross-sectional	Convenient	Nonrandomized	89	11–14 y	CPQ_{11-14}
Kok et al, 2004[32]	Cross-sectional	Community	Nonrandomized	204	10–12 y	CPQ_{11-14}
Klages et al, 2004[33]	Cross-sectional	Community	Nonrandomized	148	18–30 y	Psychologic scales (2)
de Oliveira and Sheiham, 2004[34]	Cross-sectional	Community	Randomized	1675	15–16 y	OIDP, OHIP-14
de Oliveira and Sheiham, 2003[35]	Cross-sectional	Community	Randomized	1675	15–16 y	OIDP, OHIP-14
O'Brien et al, 2003[36]	Longitudinal	Convenient	Consecutive	174	8–10 y	Psychologic scales (3)
Mandall et al, 2000[37]	Cross-sectional	Community	Randomized	434	14–15 y	Oral Aesthetic Subjective Impact Scale

[a] **Generic HRQOL measures used:** WHOQOL-BREF indicates World Health Organization Quality-of-Life Scale-Short Version (WHOQOL-Bref); SF-36, Medical Outcomes Study 36-Item Short Form. **OHRQoL measures used:** CPQ indicates Child Perceptions Questionnaire; COHIP, Child Oral Health Impact Profile; SOHSI, Subjective Oral Health Indicators; OIDP, Oral Impacts on Daily Performance; PIDAQ, Psychological Impact of Dental Aesthetics Questionnaire; and OHIP-14, Oral Health Impact Profile Short Version. **Psychological scales used:** (1) General health questionnaire; Rosenberg Self-Esteem Scale; Center for Epidemiological Studies Depression Scale; Satisfaction with Life Scale; Perceived Stress Scale; Perceived Stress Scale; World Health Organization WHOQOL-BREF Quality of Life Scale; Iowa-Netherlands Comparison Orientation Measure; Social Interaction Anxiety Scale; Social Phobia Scale; Generalized Self-Efficacy Scale; The Life Events Inventory; Health Values Scale; Dental Health Beliefs; (2) Social Appearance Concern; Appearance Disapproval; Dental Self-Confidence Scale; (3) Piers-Harris Children's Self-Concept Scale; The Childhood Experience Questionnaire; Consumer Perceptions of Orthodontic Treatment Questionnaire; Perception of the Benefits of Orthodontic Treatment Scale.

[b] DAI indicates Dental Aesthetic Index; IOTN, Index of Orthodontic Treatment Need; IOTN_AC, Index of Orthodontic Treatment Need, Aesthetic Component; IOTN_DHC, Index of Orthodontic Treatment Need, Dental Health Component; ICON, Index of Complexity, Outcome and Need; and PAR, Peer Assessment Rating.

(HRQoL) has been used to describe an individual's assessment of how the following factors affect his or her well-being: experience of pain/discomfort, physical function, psychology (ie, concerning the person's appearance and self-esteem), and social function (such as interactions with others).[10] When these considerations focus on orofacial concerns, oral health–related quality of life (OHRQoL) is assessed.[11]

The physical, social, and psychologic consequences of malocclusion and its influence on QoL have long been topics of research.[12] Moreover, over the past two decades a number of specific OHRQoL measures have been developed to assess the impact of oral health status on QoL and to assess the outcomes of oral health care intervention in terms of contribution to QoL.[13] However, there is a paucity of systematic appraisal of the consequences of malocclusion on QoL. This is important to provide an understanding of the importance of, and priority for, orthodontic care within the health care spectrum. Thus, the aim of this review was to assess the literature related to the impact of malocclusion, orthodontic treatment need, and orthodontic care on QoL, HRQoL, and OHRQoL.

MATERIALS AND METHODS

Four electronic databases (MEDLINE via PubMed, EMBASE, CENTRAL, and CINAHL) were searched for

Table 1. Extended

Occlusal Indices[b]	Impact on QoL/HRQoL/OHRQoL: Overall	Physical Domains	Psychologic Domain	Social Domain	Statistical Analysis: QoL Univariate Analysis	Spearman Correlation (r_s)	Multiple Regression (B or OR)	Level of Evidence[14]
DAI	Yes	No	Yes	Yes	$P < .05$	-	B: 3.00–4.78	2c
IOTN_AC	Yes	-	-	-	Not significant	-	-	2c
IOTN_DHC	Yes	No	Yes	Yes	$P = .012$	-	-	3b
Subjective DFI scores	Yes	Yes	Yes	Yes	-	0.45	-	3b
ICON	Yes	Yes	Yes	Yes	$P = .031–.048$	-	-	1b
DAI; PAR	Yes	No	Yes	Yes	$P = .006–.158$	0.30-0.31	-	3b
Severity Score	Yes	Yes	Yes	Yes	$P < .001$	-	-	3b
DAI	Yes	Yes	Yes	Yes	$P = .001–.831$	-	OR: 2.6–3.7	2c
ICON	Yes	Yes	Yes	Yes	$P = .031–.048$	-	-	1b
Overjet; Spacing	Yes	-	-	-	$P < .001–.002$	-	-	3b
IOTN	Yes	-	-	-	$P < .001$	-	-	2c
IOTN_AC; IOTN_DHC	Yes	Yes	Yes	Yes	$P = .017–.122$	-	-	1b
DAI	Yes	No	Yes	Yes	$P < .01$	-	OR: 4.3	2c
DAI	Yes	-	-	-	$P = .001–.831$	-	OR: 1.6–3.7	2c
IOTN_AC; DAI_modified	Yes	-	Yes	Yes	$P < .001$	-	-	2c
DAI	Yes	No	Yes	Yes	$P < .05$	-	-	2c
IOTN	No	-	-	-	$P > .05$	-	-	3b
IOTN_AC;	Yes	No	Yes	No	$P = .017$	0.151–0.184	-	2c
IOTN_AC	Yes	No	Yes	Yes	$P < .001–.034$	-	-	2c
IOTN_DHC	Yes	Yes	Yes	Yes	$P < .001$	-	OR = 2.65	2c
IOTN_DHC	Yes	Yes	Yes	Yes	-	-	OR = 1.46–2.65	2c
Class II Division 1	Yes	Yes	Yes	Yes	$P < .005$	-	-	1b
IOTN_AC; IOTN_DHC	Yes	-	Yes	Yes	-	-	B: 0.78	2c

articles published between January 1960 and December 2007 in English, French, German, Spanish, Chinese, or Japanese. In MEDLINE via PubMed, the following search syntax was used: ('quality of life' [MeSH term] OR life quality [text word] OR well being [text word] OR daily living [text word] OR physical impact [text word] OR social impact [text word] OR psychological impact [text word]) AND ('malocclusion' [MeSH term] OR 'orthodontics' [MeSH term]). In the other three databases, similar search strategies were used.

In addition, the following specific orthodontic periodicals from 1990 onward were hand-searched at a university library for articles relating to QoL, malocclusion, and orthodontics: *American Journal of Orthodontics and Dentofacial Orthopedics, European Journal of Orthodontics, Angle Orthodontist, Journal of Orthodontics*, and *World Journal of Orthodontics.*

Abstracts from the electronic and manual searches formed a list of potentially relevant studies. Three independent researchers reviewed the titles and abstracts of all potentially relevant studies independently. Where it was apparent from the abstract that the study subjects were inappropriate for the focus of the review (in terms of exclusion criteria), full-text articles of these studies were not obtained. The reference lists of articles deemed eligible for the review were checked, and where relevant, referenced papers were added to the list of potentially relevant studies through reference linkage.

Next, the full text of all potentially relevant papers was obtained and reviewed for (1) method of assessing OHRQoL, (2) use of standardized measures of malocclusion and/or orthodontic treatment need, and (3) methods of statistical analyses. This identified eligible papers relevant to this review. Exclusion criteria were lack of standardized measures in assessing QoL, HRQoL, or OHRQoL; lack of effective statistical analyses; and case reports and review papers (Figure 1).

Papers included in the final review were assessed using the following parameters: (1) study design; (2) sample (source, sampling technique, sample size, and age characteristics); (3) assessment method of OHRQoL; (4) assessment method of malocclusion and/or orthodontic treatment need; (5) key findings and statistical inference(s); and (6) level of scientific evidence based on the criteria of the Oxford Centre for Evidence-based Medicine[14] (Table 1[15–37]).

RESULTS

A list of 134 articles was obtained from the searches of electronic databases (Figure 1). A manual search

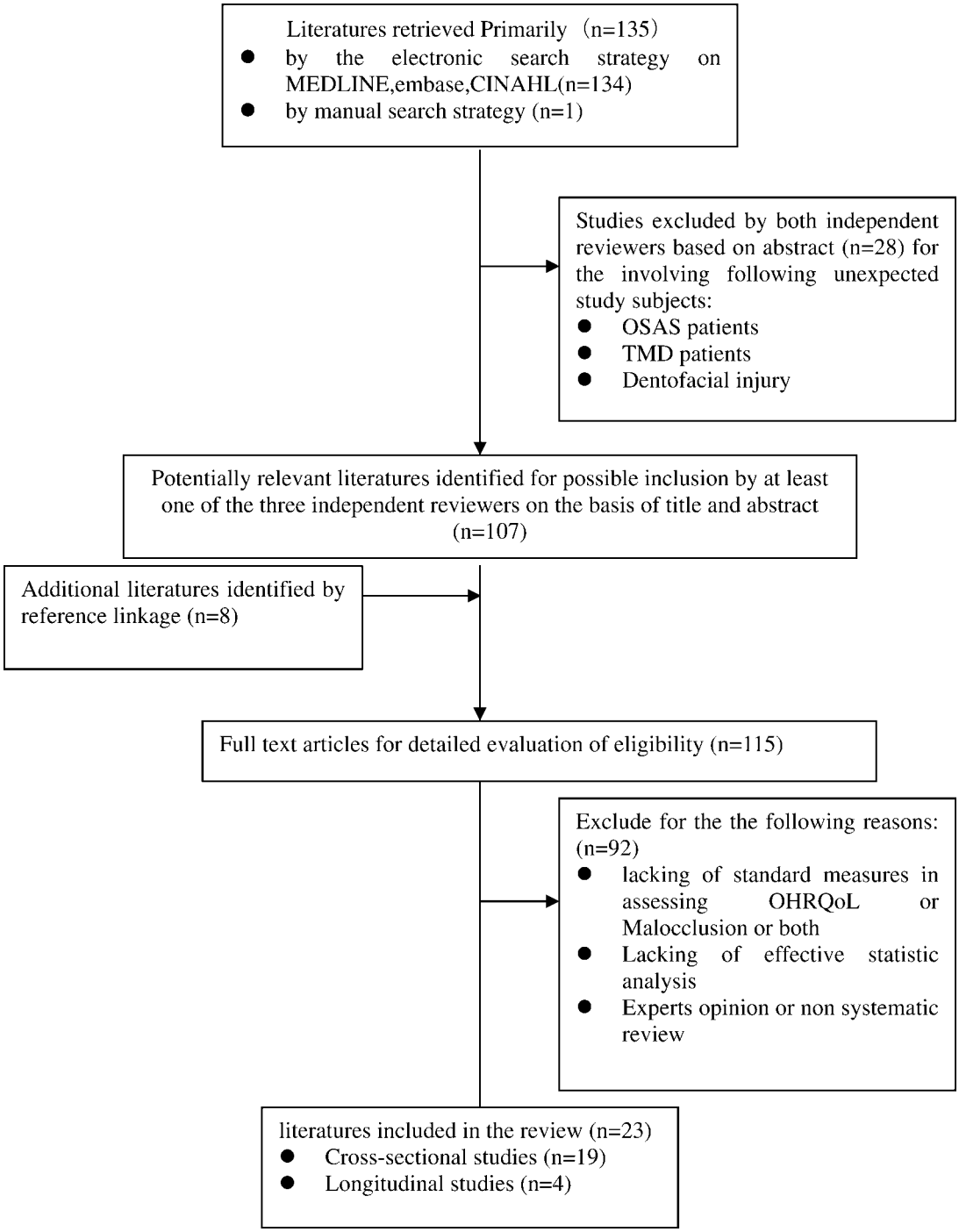

Figure 1. Flow diagram of literature search strategy.

of the orthodontic periodicals added one more article for this review. Following review of the abstract details of the 135 articles, 28 articles were excluded from the list of potentially eligible papers based on the study sample characteristics: obstructive sleep apnea patients, temporomandibular disorder patients, and dentofacial injury patients.

Full texts of the remaining 107 papers were obtained; from their references, eight more articles were reference linked as potentially relevant articles and their full texts obtained. One hundred fifteen articles were reviewed for assessment methods used in assessing HRQoL and malocclusion/orthodontic treatment need and statistical analyses. Agreement between reviewers occurred for 86% (99/115) of the papers, and disagreements were resolved through dis-

cussion prior to further assessment of the papers. Of the 115 selected papers, 92 were excluded based on the use of nonstandardized assessment methods of OHRQoL (measures whose reliability and validity had not been reported in the literature), malocclusion, and/or orthodontic treatment need. Twenty-three papers were identified as ''included'' papers to form the basis of the review.

The 23 included papers[15–37] were identified from 20 studies. Among the 23 included papers, four offered level 1b evidence (cohort studies with good follow-up), 13 offered level 2c evidence (large community/ecologic studies), and six were level 3b evidence (cross-sectional studies among convenient samples) according to the Oxford Centre for Evidence-based Medicine criteria.[14] Sixteen articles used community samples (sample size ranged from 148 to 1675) and seven used convenient clinical samples (sample size ranged from 89 to 193). Eighteen of the articles described findings in child/adolescent study populations, and five described findings in adult populations.

Both generic and oral health–specific QoL measures were employed in assessing the effects of malocclusion/orthodontic treatment need on life quality. Among children and adolescents, the Child Perception Questionnaire (CPQ) was the most frequently employed measure (9 of 18 papers). Among adults the Oral Impact on Daily Performance (OIDP) measure was most frequently used in the assessment of OHRQoL (two of five papers).

Subjects in most studies were classified according to their orthodontic treatment need rather than by occlusal traits. The Index of Orthodontic Treatment Need (IOTN) was most frequently employed in classifying the study population clinically (10 of 23 papers).

Because of the heterogeneity of different methods of assessing malocclusion/orthodontic treatment need and OHRQoL, it was not feasible to combine the statistical results to form a meta-analysis. However, the majority of the findings from cross-sectional studies indicated an association between QoL (irrespective of how it was assessed) and malocclusion/orthodontic treatment need (irrespective of how it was assessed) ($P < .05$). The strength of the correlation (r value) between malocclusion/orthodontic treatment need status and QoL, where reported, ranged from 0.15 to 0.45. The regression analyses (linear and logistic) showed that the strength of the association between malocclusion/orthodontic treatment need status and QoL was above 4.0 for some studies (adjusted odds ratio/regression coefficient) (Table 1).

DISCUSSION

QoL is a somewhat intangible entity and there has been much debate as to how to define it. However, since there is general consensus that QoL reflects physical, social, and psychologic functioning, these terms formed the basis of the literature search methodology.[9] The literature search yielded more than 100 potentially relevant articles, demonstrating the paradigm shift from the biophysical focus of malocclusion to a more patient-centered focus of malocclusion and its management. Moreover, it was apparent that QoL has been a particularly common topic of research in the past decade among all dental disciplines.[38]

In this review a rather stringent approach was taken to the selection of included papers; this approach was based on the requirement of standardized assessment methods for malocclusion/orthodontic treatment need and for HRQoL. This process was used since assessment methods (for both malocclusion/orthodontic treatment need and HRQoL) have been available for more than two decades and because the use of nonstandardized assessment methods makes it difficult to draw conclusions about QoL, itself already an elusive concept.[13,38] For the most part, OHRQoL measures have been employed, rather than generic HRQoL measures, in the assessment of the impact of malocclusion on QoL, which would seem appropriate given the greater sensitivity of condition-specific measures.[12]

Perhaps not too surprisingly, the majority of the research in this area has focused on the impact of malocclusion on the QoL in children rather adults. This relates in part to the fact that children make up the majority of orthodontic patients, although it is increasingly recognized that more and more adults are seeking correction of their malocclusion.[39]

The level or strength of evidence that can be gleaned from the included papers was relatively low. Most were cross-sectional studies, since the research questions were concerned primarily with identifying an association between malocclusion and QoL rather than outcomes of treatment. It is uncertain as to whether a higher level of evidence will emerge in the future, since orthodontics frequently does not lend itself to randomized controlled trials very well because of ethical issues, particularly when children are involved.[40] Of note, studies generally observed an association between malocclusion/orthodontic treatment need and HRQoL, irrespective of how the parameters were assessed. However, the inferences from the correlation statistics and regression findings would indicate that, at best, the strength of the association could be interpreted as moderate.

CONCLUSIONS

- There is a growing interest in the relationship between malocclusion/orthodontic treatment need and HRQoL.

- This review suggests that there is an association (albeit modest) between malocclusion/orthodontic treatment need and poor HRQoL, and that they coexist in the same population.
- There is a need to determine appropriate assessment methods of malocclusion/orthodontic treatment need and of quality of life (QoL, HRQoL, and/or OHRQoL measures) to enable meta-analysis of their relationship.

REFERENCES

1. Jenny J. A social perspective on need and demand for orthodontic treatment. *Int Dent J.* 1975;25:248–256.
2. Mohlin B, al-Saadi E, Andrup L, Ekblom K. Orthodontics in 12-year old children. Demand, treatment motivating factors and treatment decisions. *Swed Dent J.* 2002;26:89–98.
3. Petersen P, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ.* 2005;83:661–669.
4. Cons NC, Jenny J, Kohout FJ, Songpaisan Y, Jotikastira D. Utility of the dental aesthetic index in industrialized and developing countries. *J Public Health Dent.* 1989;49:163–166.
5. Daniels C, Richmond S. The development of the index of complexity, outcome and need (ICON). *J Orthod.* 2000;27: 149–162.
6. Richmond S, Shaw WC, O'Brien KD, et al. The development of the PAR Index (Peer Assessment Rating): reliability and validity. *Eur J Orthod.* 1992;14:125–139.
7. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. *Eur J Orthod.* 1989;11:309–320.
8. Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. *Am J Orthod.* 1985;87:21–26.
9. Bowling A. *Measuring Health: A Review of Quality of Life Measurement Scales.* 3rd ed. Maidenhead, Berkshire, England: Open University Press; 2005:1–7.
10. World Health Organization. Study protocol for the World Health Organization project to develop a Quality of Life assessment instrument (WHOQOL). *Qual Life Res.* 1993;2: 153–159.
11. Inglehart M, Bagramian R. *Oral Health–Related Quality of Life.* Chicago, Quintessence Publishing; 2002:1–6.
12. Cunningham SJ, Hunt NP. Quality of life and its importance in orthodontics. *J Orthod.* 2001;28:152–158.
13. Allen PF. Assessment of oral health related quality of life. *Health Qual Life Outcomes.* 2003;1:40.
14. Heneghan C, Badenoch D. Levels of evidence and grades of recommendation. In: Heneghan C, Badenoch D. *Evidence-Based Medicine Toolkit.* London, England: BMJ Books. 2002;51–54.
15. Do LG, Spencer A. Oral health-related quality of life of children by dental caries and fluorosis experience. *J Public Health Dent.* 2007;67:132–139.
16. Locker D. Disparities in oral health-related quality of life in a population of Canadian children. *Community Dent Oral Epidemiol.* 2007;35:348–356.
17. O'Brien C, Benson PE, Marshman Z. Evaluation of a quality of life measure for children with malocclusion. *J Orthod.* 2007;34:185–193; discussion 176.
18. Dunlow N, Phillips C, Broder HL. Concurrent validity of the COHIP. *Community Dent Oral Epidemiol.* 2007;35(suppl 1): 41–49.
19. Shaw WC, Richmond S, Kenealy PM, Kingdon A, Worthington H. A 20-year cohort study of health gain from orthodontic treatment: psychological outcome. *Am J Orthod Dentofacial Orthop.* 2007;132:146–157.
20. Locker D, Jokovic A, Tompson B, Prakash P. Is the Child Perceptions Questionnaire for 11-14 year olds sensitive to clinical and self-perceived variations in orthodontic status? *Community Dent Oral Epidemiol.* 2007;35:179–185.
21. Tajima M, Kohzuki M, Azuma S, Saeki S, Meguro M, Sugawara J. Difference in quality of life according to the severity of malocclusion in Japanese orthodontic patients. *Tohoku J Exp Med.* 2007;212:71–80.
22. Traebert ES, Peres MA. Do malocclusions affect the individual's oral health-related quality of life? *Oral Health Prev Dent.* 2007;5:3–12.
23. Kenealy PM, Kingdon A, Richmond S, Shaw WC. The Cardiff dental study: a 20-year critical evaluation of the psychological health gain from orthodontic treatment. *Br J Health Psychol.* 2007;12:17–49.
24. Johal A, Cheung MY, Marcene W. The impact of two different malocclusion traits on quality of life. *Br Dent J.* 2007; 202:E2.
25. Tsakos G, Gherunpong S, Sheiham A. Can oral health-related quality of life measures substitute for normative needs assessments in 11 to 12-year-old children? *J Public Health Dent.* 2006;66:263–268.
26. O'Brien K, Wright JL, Conboy F, Macfarlane T, Mandall N. The child perception questionnaire is valid for malocclusions in the United Kingdom. *Am J Orthod Dentofacial Orthop.* 2006;129:536–540.
27. Marques LS, Ramos-Jorge ML, Paiva SM, Pordeus IA. Malocclusion: esthetic impact and quality of life among Brazilian schoolchildren. *Am J Orthod Dentofacial Orthop.* 2006;129: 424–427.
28. Traebert ES, Peres MA. Prevalence of malocclusions and their impact on the quality of life of 18-year-old young male adults of Florianopolis, Brazil. *Oral Health Prev Dent.* 2005; 3:217–224.
29. Klages U, Claus N, Wehrbein H, Zentner A. Development of a questionnaire for assessment of the psychosocial impact of dental aesthetics in young adults. *Eur J Orthod.* 2006;28:103–111.
30. Foster PLA, Thomson WM, Jokovic A, Locker D. Validation of the Child Perceptions Questionnaire (CPQ 11-14). *J Dent Res.* 2005;84:649–652.
31. Marshman Z, Rodd H, Stern M, et al. An evaluation of the Child Perceptions Questionnaire in the UK. *Community Dent Health.* 2005;22:151–155.
32. Kok YV, Mageson P, Harradine NW, Sprod AJ. Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN) in assessing orthodontic treatment need and concern. *J Orthod.* 2004;31:312–318; discussion 300–311.
33. Klages U, Bruckner A, Zentner A. Dental aesthetics, self-awareness, and oral health-related quality of life in young adults. *Eur J Orthod.* 2004;26:507–514.
34. de Oliveira CM, Sheiham A. Orthodontic treatment and its impact on oral health-related quality of life in Brazilian adolescents. *J Orthod.* 2004;31:20–27; discussion 15.
35. de Oliveira CM, Sheiham A. The relationship between normative orthodontic treatment need and oral health-related quality of life. *Community Dent Oral Epidemiol.* 2003;31: 426–436.
36. O'Brien K, Wright J, Conboy F, et al. Effectiveness of early orthodontic treatment with the Twin-block appliance: a multicenter, randomized, controlled trial. Part 2: Psychosocial

effects. *Am J Orthod Dentofacial Orthop.* 2003;124:488–494; discussion 494–495.
37. Mandall NA, McCord JF, Blinkhorn AS, Worthington HV, O'Brien KD. Perceived aesthetic impact of malocclusion and oral self-perceptions in 14-15-year-old Asian and Caucasian children in greater Manchester. *Eur J Orthod.* 2000;22:175–183.
38. Locker D. Oral health and quality of life. *Oral Health Prev Dent.* 2004;2(suppl 1):247–253.
39. Nattrass C, Sandy JR. Adult orthodontics—a review. *Br J Orthod.* 1995;22:331–337.
40. Cunningham SJ, Jones SP, Hodges SJ, et al. Advances in orthodontics. *Prim Dent Care.* 2002;9:5–8.