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Prediction of compliance and completion of orthodontic treatment: are quality of life measures important?

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SUMMARY The main aim of the present investigation was to evaluate whether there is an association between completion of orthodontic treatment and quality of life measures, i.e. age, gender, socio-economic status, type of appliance and need for orthodontic treatment. The secondary aim was to evaluate whether compliance with orthodontic treatment (missed appointments and appliance breakages) was associated with age, gender, socio-economic status, or type of appliance. This was a multi-centre longitudinal observational study carried out on 144 patients (65 males and 79 females) aged 10–19 years.

Baseline data were collected: patient age, gender, socio-economic status, Index of Orthodontic Treatment Need (IOTN), and type of appliance. Quality of life information, including orthodontic utility values and oral aesthetic subjective impact score (OASIS), were also collected at the start of treatment. The main outcome measure was whether a patient completed treatment. Compliance was assessed by recording the number of failed appointments and appliance breakages. Multiple regression analysis was used to investigate the association between independent and dependent variables.

None of the baseline variables, including quality of life measures, were associated with a patient completing treatment, or their compliance with treatment ($P > 0.05$). Thus, quality of life measures (utility values or OASIS) do not add to our knowledge of who may complete, or co-operate with, orthodontic treatment. In addition, neither age, gender, socio-economic status nor clinical treatment need (IOTN) were useful in helping a clinician to choose potentially co-operative patients.

Introduction

Allocation of resources for orthodontics, in the future, may be influenced by quality of life indicators (Cunningham and Hunt, 2001). Quality of life measures are becoming increasingly important, since clinician-based measures of treatment need not take into account patient perceptions or opinions. Although access to orthodontic services is limited by clinical need, health service use is also driven by demand for treatment which is influenced by the less tangible consumer-based factors that cause a person to seek care. Quality of life measures aim to capture these multiple consumer-based factors and it may be advantageous to combine such information with clinician-based measures of orthodontic need.

Quality of life measures have been developed in dentistry based on a conceptual framework to help explain the multidimensional nature of the impact of oral health on daily life (Locker, 1988). Locker defined various categories in relation to oral health as handicap, disability, discomfort, functional limitation, impairment, disease, and death (Figure 1). Most of the subsequent quality of life dental measures have been developed as questionnaires tested on adults, some of which were accompanied by a clinical examination (Cushing *et al.*, 1986; Locker and Grushka, 1987; Rosenberg *et al.*, 1988; Gooch *et al.*, 1989; Reisine *et al.*, 1989; Atchison and Dolan, 1990; Strauss and Hunt, 1993; Locker and Miller, 1994a,b; Slade and Spencer, 1994; Adulyanon *et al.*, 1996; Kressin *et al.*, 1996; Strauss, 1996; Tickle *et al.*, 1997; Gilbert *et al.*, 1998; Awad *et al.*, 2000; Nuttall *et al.*, 2001). Importantly, few quality of life measures have been developed in orthodontics or for children, but recent work has suggested that utility values (Fox, 1997) and oral aesthetic subjective impact scores (OASIS; Mandall *et al.*, 1999) may be useful.

Utility value as a measure of quality of life

A utility value is a number that, in theory, represents a condensation of biological, physical, sociological, and psychological parameters that influence a person's sense of well-being. They represent the values that individuals hold for certain states of health or disease. O'Brien *et al.* (1998) showed that seekers of orthodontic treatment had lower utility values than children who did not seek orthodontic care, i.e. those seeking treatment perceived their aesthetic dental appearance to be less acceptable.

OASIS as a measure of quality of life

OASIS consists of a series of questions to assess the degree of concern/disadvantage that children feel because of the arrangement of their teeth (Mandall *et al.*, 1999). Children were asked to indicate, on a seven-point Likert scale, their concern about tooth appearance, nice comments about teeth, unpleasant comments about teeth, teasing about teeth, avoidance of smiling, and covering the mouth. These scores were then added to the child's self-perceived Aesthetic

Component of the Index of Orthodontic Treatment Need (IOTN-AC), (Brook and Shaw, 1989; Figure 2) score to obtain the OASIS. A higher score indicated more concern/negative impact from their tooth arrangement. This work suggested that the higher a child's concern about the appearance of their teeth, the more likely they were to want orthodontic treatment.

Therefore, it is suggested that if these orthodontic quality of life measures can predict a wish for and uptake of orthodontic services, maybe such patients would place a higher value on their dental appearance and be more co-operative with treatment.

If it were possible to predict co-operative patients, potentially treatment discontinuation levels may reduce.

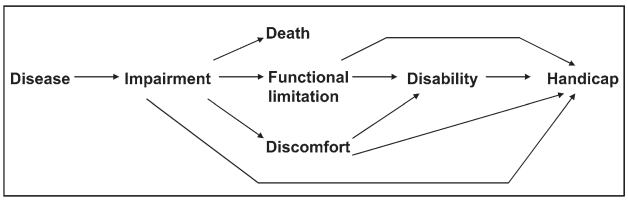

Figure 1 Locker's conceptual framework for oral disease showing the potential impact of dental conditions on daily life.

Discontinuation rates have been reported to be between 12 and 20 per cent (Haynes, 1982; Murray, 1989) increasing to around 40 per cent in 15- to 17-year olds (Haynes, 1991). This has obvious implications in terms of wasted resources, where appliances are placed but have little occlusal benefit before treatment is stopped.

A number of predictors of poor co-operation have been identified including some psychological tests such as the Psychological Test, Achievement and Affiliation Motivation Test and Attribution Motivation Test (El-Mangoury, 1981; Egolf *et al.*, 1990), patient attitude at the beginning of treatment (Sergl *et al.*, 1998), and use of removable appliances (Murray, 1989). In contrast, headgear compliance was seen to increase with the use of headgear calendars (Cureton *et al.*, 1993) and general compliance appears to be influenced by a positive orthodontist–patient relationship with good communication about patient concerns and treatment options (Sinha *et al.*, 1996).

However, the role of quality of life measures on completion and compliance with orthodontic treatment has not been investigated and, thus, formed the focus of this study.

The main aim was to evaluate whether there is an association between completion of orthodontic treatment and quality of life measures, age, gender, socio-economic status,

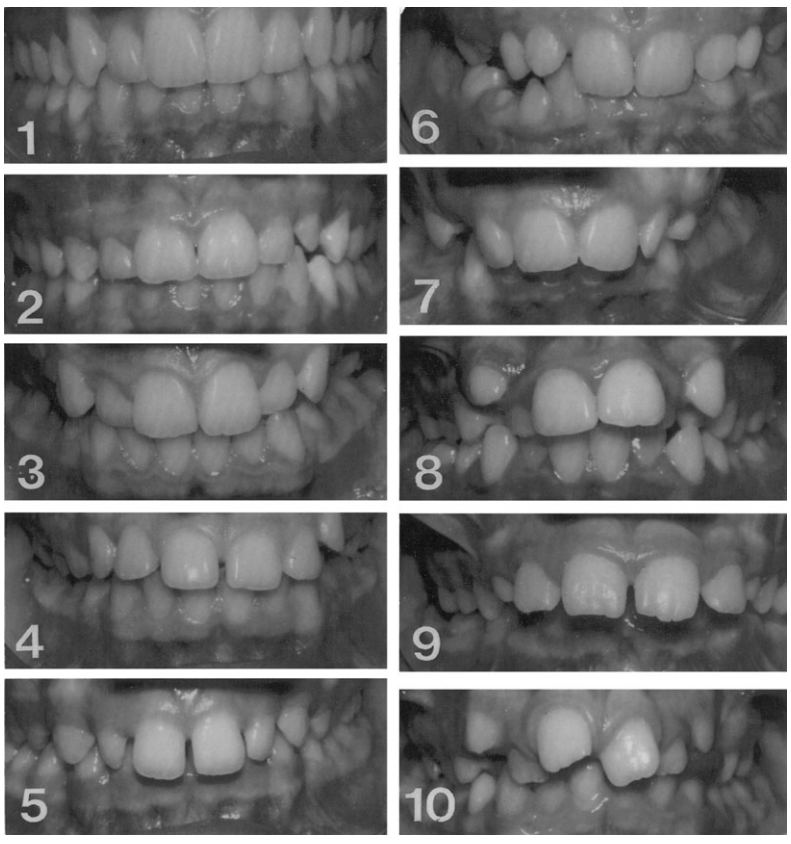

Figure 2 The Aesthetic Component of the Index of Orthodontic Treatment Need published with permission from Evans R, Shaw W 1987 Preliminary evaluation of an illustrated scale for rating dental attractiveness. European Journal of Orthodontics 9: 314–318.

type of appliance, and need for orthodontic treatment (IOTN; Brook and Shaw, 1989). The secondary aim was to evaluate whether compliance with orthodontic treatment (missed appointments and appliance breakages) was associated with age, gender, socio-economic status, or type of appliance.

Sample

Consecutive subjects at the start of active orthodontic treatment were investigated. The population comprised 10- to 19-year-old subjects from the University Dental Hospital of Manchester, Bolton Royal Hospital, St Anne's Orthodontic Practice, and Hope Hospital, Salford, UK. Three orthodontists carried out the treatment (NAM, DF, and JM).

Sample size calculation

It has been shown that 80 per cent of patients who are accepted for orthodontic treatment are in IOTN grades 4 or 5, the remaining 20 per cent in grade 3 or below (Mandall, 1997). As previously outlined, compliance has been reported to be between 12 and 40 per cent. Therefore, it was assumed that 10 per cent of those with high need and 35 per cent with a low need may fail to complete a course of orthodontic treatment. A two-group continuity-corrected chi-square test, with a 0.050 two-sided significance level, will have an 80 per cent power to detect the difference between a proportion of 0.10 in a high treatment need group and 0.350 in a low treatment need group (odds ratio of 4.85) when the sample sizes are 112 and 28, respectively. Thus, a total sample size of 140 patients was required.

Method

Ethical approval was obtained from Central Manchester, Bolton, Salford, and Trafford and Blackpool, Wyre, and Fylde ethics committees. Written consent was obtained from the patient and a parent or legal guardian.

Baseline age, gender, and socio-economic status

The date of birth and date of start of treatment was recorded and used to calculate age at the start of treatment. Gender and type of appliance was also noted. Socio-economic status was evaluated using Townsend deprivation scores (Townsend, 1987) whereby postcode data obtained from the child was linked to the place in which they lived. Then, using a postcode directory from data sets information of the United Kingdom (U.K.) Census (1991) a deprivation score was calculated where a higher score indicates increased social deprivation.

Index of Orthodontic Treatment Need

Start of treatment study models were scored for the AC and dental health component (DHC) of the IOTN by SM, a calibrated examiner. Intra-examiner reliability was tested by re-scoring 20 models, at least 1 week later.

Quality of life: utility score

Utility values were measured by referring to the IOTN-AC 8, 5, and 3 (Figure 2). Aesthetic scores were measured relative to the best state (AC = 1) and the worst state (AC = 10) by presenting subjects with standard photographs. For example, the subject was asked to choose whether they would prefer (1) the appearance of AC 8 for the next 20 years or (2) the appearance of AC 10 for 1 year and AC 1 for the remaining 19 years.

The number of years of appearance AC 10 was varied (increasing up to 20) until a point of indifference was reached between the two alternatives. Thus, the subject expressed the number of years they would be prepared to trade-off a poor appearance to ultimately achieve a good appearance. A higher utility score indicated a higher value placed on aesthetic tooth appearance.

Quality of life: OASIS

A series of questions assessed the degree of concern/disadvantage that children felt because of the arrangement of their teeth (Mandall *et al.*, 1999). Children were asked to indicate, on a seven-point Likert scale, their concern about tooth appearance, nice comments about teeth, unpleasant comments about teeth, teasing about teeth, avoidance of smiling, and covering the mouth. These scores were then added to the child's self-perceived IOTN-AC score to obtain the OASIS. A higher score indicated more concern/negative impact from their tooth arrangement.

Measurement of compliance with treatment

Whether the patient completed the course of treatment was recorded together with the reason for non-completion. The reasons for non-completion included poor oral hygiene, failed appointments, or appliance breakages. The number of failed/cancelled appointments and the number of appliance breakages were recorded from the case notes, at the end of treatment, to give a further indicator of compliance with treatment.

Statistics analysis

Descriptive statistics were generated and the data were checked for normality. Statistical analysis was carried out on the whole sample ($n = 144$). Multiple regression analysis models were used to investigate the association between the baseline variables (independent variables) and patient completion of and co-operation with treatment (dependent variables).

Multiple regression analysis allows the effect of multiple variables to be assessed at the same time. Therefore, where completion of treatment was considered, the following potential explanatory variables were entered into the model: utility value, OASIS, age, gender, socio-economic status,

type of appliance, and IOTN score. For compliance with treatment (missed appointments or breakages) the following potential explanatory variables were entered: age, gender, socio-economic status, and type of appliance.

Results

The weighted kappa value for examiner calibration was 0.86, standard error (SE) kappa 0.06, 95 per cent confidence interval (CI) 0.74–0.97 for the AC and DHC of IOTN. Intra-examiner reliability for the use of this index was as follows—AC: weighted kappa 0.81, SE kappa 0.06, 95 per cent CI 0.69–0.93, and DHC: weighted kappa 0.82, SE kappa 0.12, 95 per cent CI 0.61–1.00.

One hundred and fifty-five patients were registered, of which 11 declined to proceed with treatment. Therefore, the analysis was carried out on 144 subjects. The mean age at the start of treatment was 13.7 years [standard deviation (SD) 2.1 years] with a range of 9.6–19.0 years. There were 65 males (45 per cent) and 79 females (55 per cent) and the mean treatment duration was 16.6 months (SD = 9.3 months). Tables 1, 2 and 3 show descriptive statistics for the baseline variables and indicators of co-operation.

Of these 144 subjects, 82 completed treatment (57 per cent) and 62 (43 per cent) did not. For the 62 patients not completing treatment, the primary reasons for this were as follows: poor oral hygiene (n =19, 31 per cent); multiple failed appointments (n = 27, 43 per cent); appliance breakages (n = 10, 16 per cent); and reason not recorded (n = 6, 10 per cent).

There was no statistically significant difference between operators for patients who completed/did not complete treatment (chi-square value 4.89, 2 degrees of freedom, $P = 0.09$) or for the number of failed or cancelled appointments [analysis of variance (ANOVA) F ratio 1.7, P value = 0.18, 95 per cent CI −1.32 to 0.23]. However, there was a statistically significant difference between operators NAM and DF only, for number of appliance breakages (ANOVA F ratio 6.0, P value 0.003, 95 per cent CI 0.56 to 3.18).

Multiple regression analysis to investigate whether need for treatment or quality of life measures influenced completion of, or compliance with, orthodontic treatment

Importantly, none of the baseline variables, including quality of life measures, age, gender, socio-economic status, type of appliance, or IOTN score showed an association with completion of orthodontic treatment (logistic regression analysis; $P > 0.05$). In addition, multiple linear regression analysis revealed neither age, gender, and socio-economic status nor type of appliance to be significantly associated with the number of appliance breakages or number of failed/cancelled appointments ($P > 0.05$).

Table 1 Descriptive statistics for baseline variables and indicators of co-operation for the entire sample of patients (n = 144).

	Mean (SD)
Baseline variable	
Townsend score (socio-economic status; higher score, increased deprivation)	2.2 (4.0)
Utility score (higher score = increased value on aesthetic appearance)	
IOTN-AC 3	0.8 (0.2)
IOTN-AC 5	0.7 (0.3)
IOTN-AC 8	0.6 (0.3)
OASIS (higher score = increased psychosocial impact of malocclusion)*	21.1 (7.4)
Treatment compliance indicators	
Appliance breakages	2.0 (2.9)
By operator	
DF	3.3 (4.2)
NAM	1.4 (2.1)
JM	1.9 (1.6)
Failed/cancelled appointments†	1.4 (1.6)
By operator	
DF	1.8 (2.0)
NAM	1.4 (2.1)
JM	1.9 (1.6)

IOTN-AC, Aesthetic Component of the Index of Orthodontic Treatment Need; OASIS, oral aesthetic subjective impact score quality of life measure; SD, standard deviation.
*Overall, 62 patients had one or more appliance breakage.
†Overall, 52 patients had one or more failed appointments.

Table 2 Descriptive statistics for baseline variables and indicators of co-operation for those who did and did not complete treatment (n = 144).

	Mean (SD)	
	Completed treatment	Did not complete treatment
Baseline variable		
Townsend score (socio-economic status; higher score, increased deprivation)	1.7 (3.7)	2.5 (4.1)
Utility score (higher score = increased value on aesthetic appearance)		
IOTN-AC 3	0.9 (0.2)	0.9 (0.2)
IOTN-AC 5	0.7 (0.2)	0.7 (0.3)
IOTN-AC 8	0.6 (0.3)	0.6 (0.3)
OASIS (higher score= increased psychosocial impact of malocclusion)	20.2 (7.6)	22.4 (7.1)
Treatment compliance indicators		
Appliance breakages	1.8 (2.1)	2.2 (3.7)
Failed/cancelled appointments	0.9 (1.3)	2.2 (1.8)

IOTN-AC, Aesthetic Component of the Index of Orthodontic Treatment Need; OASIS, oral aesthetic subjective impact score quality of life measure; SD, standard deviation.

Discussion

This study has found that quality of life utility scores and OASIS questionnaire, clinical treatment need, age, gender, socio-economic status, and type of appliance were not

Table 3 Descriptive statistics for baseline Index of Orthodontic Treatment Need (IOTN) and appliance type.

Baseline variable	Frequency (%) or mean duration of treatment in months (SD)
IOTN-Aaesthetic component	
1–4	17 (12)
5–7	68 (47)
8–10	59 (41)
IOTN Dental Health component	
1–2	3 (2)
3	13 (9)
4–5	128 (89)
Patient-perceived IOTN (n = 4 missing data)	
1–4	80 (57)
5–7	49 (35)
8–10	11 (8)
Appliance type	
Functional only	27 (19)
Fixed only	112 (78)
Removable/fixed	49 (34)
Headgear/fixed	8 (6)
Treatment duration	
Functional only	14.5 (11.3)
Fixed only	19.7 (7.8)
Removable/fixed	18.3 (10.3)
Headgear/fixed	18.5 (12.2)

useful in identifying whether a child might complete orthodontic treatment.

Effect of utility values and OASIS on co-operation with orthodontic treatment

It was surprising that quality of life measures did not influence completion of orthodontic treatment. At the time of starting this study, previous work had suggested that utility score and OASIS may influence the wish for treatment and the use of orthodontic services (Fox, 1997; Mandall *et al.*, 1999). It was hypothesized that if these quality of life indicators could predict the uptake of orthodontic services, maybe patients with higher utility values or OASIS would place a higher value on their dental appearance and be more co-operative in completing treatment. However, a more recent prospective study showed no effect of these quality of life measures on uptake of orthodontic treatment (Mandall *et al.*, 2005). It is probably, therefore, unnecessary to calculate utility values and OASIS for patients, in addition to clinical measures of need. However, another interpretation of the lack of effect of utility score on co-operation could be that the younger patients in the sample did not yet have the cognitive ability to imagine time periods of 10–20 years.

Effect of age, gender, socio-economic status, and type of appliance on co-operation

The lack of effect of age or gender on compliance agrees with Murray (1989) and Richter *et al.* (1998). In contrast, Haynes (1991) showed that 15- to 17-year-old patients had the highest discontinuation rates (39.8 per cent) compared with 10- to 14-year old patients at 21.3 per cent. Additionally, Tung and Kiyak (1998), investigating psychosocial influences on the timing of orthodontic treatment, found that 9- to 12-year-old children made more suitable candidates for orthodontic treatment. It may be that compliance with treatment may be more predictable using psychological outcomes rather than age, gender, or socio-economic status.

It was perhaps surprising that the type of appliance did not influence completion or co-operation with treatment, since Murray (1989) showed that use of removable appliances was associated with failure to complete treatment. It may be that the present data did not show this because all removable appliances were used for a short time at the beginning of a fixed phase of treatment. Therefore, the effect of a removable appliance only on completion and co-operation could not be evaluated.

Clinical need for treatment IOTN and co-operation

The lack of effect of IOTN on completion of treatment is surprising since El-Mangoury (1981) found that those with high need co-operated better, as assessed by psychometric tests. The difference in results could be explained by the measure of need in this study being clinical and the former being psychological. A study of a sample of school children in Greater Manchester showed that IOTN could be used to predict uptake of orthodontic treatment (Mandall *et al.*, 2005). Therefore, it seems that high clinical need cannot be used to predict completion of treatment, although these children are more than three times more likely to access care.

Conclusions

Age, gender, socio-economic status, type of appliance, and clinical treatment need (IOTN) are not useful in helping a clinician to choose potentially co-operative patients. Similarly, quality of life measures (utility values or OASIS) do not add to our knowledge of who may complete orthodontic treatment.

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