Repeated measurements of mood during psychologic treatment of dental fear

Magnus Hakeberg, Ulf Berggren, Sven G. Carlsson and Jan-Eric Gustafsson
Department of Endodontology/Oral Diagnosis, Faculty of Odontology; Department of Psychology; and Department of Education; Göteborg University, Göteborg, Sweden

Hakeberg M, Berggren U, Carlsson SG, Gustafsson J-E. Repeated measurements of mood during psychologic treatment of dental fear. Acta Odontol Scand 1997;55:378–383. Oslo. ISSN 0001-6357.

The aims of the present study were to analyze mood changes during psychologic treatment of dental fear by assessing the rate of improvement. Twenty-one patients who refused conventional dental treatment and reported extreme dental anxiety participated in the study. Levels of dental anxiety and mood were measured with the Dental Anxiety Scale (DAS) and a Mood Adjective Checklist (MACL). MACL included two dimensions, degree of relaxation (r) and pleasantness (h) as experienced in a dental situation. Mood was monitored at each treatment session from base line to termination of the therapy (eight measurements). Two different treatment modalities were used, one with a more cognitive approach ($n = 9$) and one emphasizing the relaxation component ($n = 12$). A hierarchical linear models approach was applied to analyze individual change with repeated measurements. The results showed that positive mood changes over time were statistically significant. The mean improvement in mood scores per week and session was estimated for MACL(r) and MACL(h) to be 0.14/week and 0.09/week, respectively. The growth was not affected by DAS levels or treatment mode. This study also illustrated a powerful method for analyzing a longitudinal clinical trial design with repeated measurements. □ *Dental fear; longitudinal analysis; mood; treatment*

Magnus Hakeberg, Department of Endodontology/Oral Diagnosis, Faculty of Odontology, Göteborg University, Medicinaregatan 12, S-413 90 Göteborg, Sweden

There is wide agreement in the literature that different behavioral/psychologic treatments of dental phobic reactions are successful both in a short and long perspective (1–8). For most dental fear patients treated with such therapies positive changes have been reported for several factors. Previous studies have shown that after psychologic treatment, dental fear patients report regular dental visiting habits, low levels of dental and general anxiety, improved mood, and eventually an improved dental health as compared with pretreatment status (1–8). The psychologic treatments used in clinical studies have usually been well described with regard to the techniques, components, and included measurement scale(s). However, little is known about the temporal course of measured variables associated with dental fear and anxiety. In most previous studies the only time points presented have been pre- and post-treatment results. Such designs are often not adequate for studying individuals' change over time. Another reason for not analyzing repeated measurements, if they have been collected, may be that suitable and powerful methods have not been applied in the statistical analyses. The advantages of using longitudinal data and analyses may be, for example, to assess individual responses to a therapy such as growth or decline in symptom improvement and to analyze whether the change pattern can be described as a linear or non-linear growth curve. In addition, therapy components may be evaluated in relation both to the continuous process and to significant covariates. As Bryk & Raudenbush state (9), the development of hierarchical linear models includes powerful statistical techniques for research on individual change. If valid measurements from multiple timepoints are available, then these methods make it possible to produce an integrated approach for studying the structure and predictors of individual growth.

Mood has been one of several different outcome meaures of dental fear treatment (3–6, 8, 10–16). Mood changes have shown a strong relationship to dental fear treatment outcome and an ability to reflect individual differences in treatment responses. In one study mood was measured with the Mood Adjective Checklist (MACL) directly after each a series of psychologic treatment sessions in a group of 11 fearful dental patients. The regression coefficients estimating individual improvement of mood over sessions was a powerful predictor of clinical treatment outcome ($R^2 = 0.76$) (12). This finding indicated that mood reflected positive treatment response, making it an interesting process measure in therapy research.

The aims of this study were to analyze the course, increment, and covariates of mood changes during treatment for dental fear.

Materials and methods

Patients and procedures

The subjects of the present investigation applied for dental fear treatment at a specialized Dental Fear

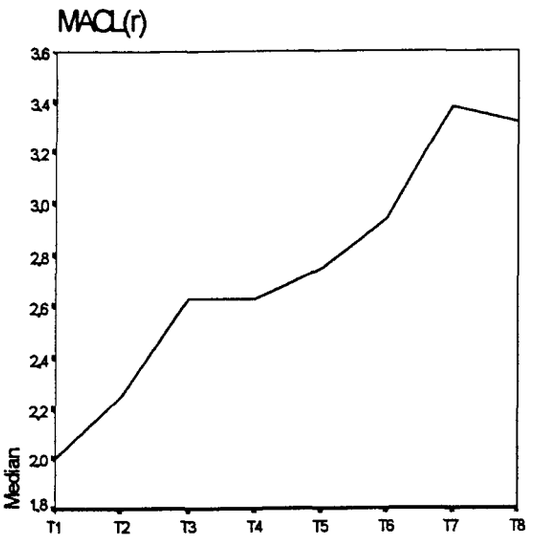

Fig. 1. The median score plot of the Mood Adjective Checklist, degree of relaxation (r) (MACL(r)), during the psychologic treatment for dental fear.

Research and Treatment Clinic (DFRTC) at the Faculty of Odontology, Göteborg University, Göteborg, Sweden. The patients were either referred from dental and medical institutions or were self-referred.

This paper describes part of a larger treatment project. The inclusion criteria were refusal of conventional dental treatment due to dental fear, an estimated dental treatment need of at least two restorations, and willingness to participate in the research project. Individuals who had psychiatric conditions were excluded and were instead treated in accordance with clinical routine.

To select the patients, a screening process was included in the study design. This procedure contained first a visit to a dentist at which a dental and medical history and background data were obtained. At a second visit the clinical psychologist interviewed the patients, using a structured interview and questionnaires.

The psychologic treatment was performed by the clinical psychologist in accordance with two protocols. A maximum of seven treatment sessions were included, but if a patient had finished the treatment in less than seven sessions, he/she continued with the dental test treatment. One psychologic treatment included relaxation training, biofeedback, and video-based systematic desensitization scenes (SD), whereas the other was a cognitively oriented therapy with SD and reorientation of the patients' negative thoughts and attitudes to dentistry (1, 3). The two treatment modalities were randomly chosen for the patients. One therapy included more relaxation-training ($n = 12$), whereas the other contained more cognitive therapy ($n = 9$); however, other therapy components were the same for both treatments.

This paper focuses on the psychologic treatment sessions and the continuous process as measured by mood as the outcome variable.

Table 1. Descriptive statistics, mean, standard deviation (*s*), and median of the mood dimensions relaxation (MACL(r)) and pleasantness (MACL(h)) on the Mood Adjective Checklist (MACL), and level of dental fear measured with the Dental Anxiety Scale (DAS)

	Initial status		Termination status	
Variable	Mean (*s*)	Median	Mean (*s*)	Median
MACL(r)	2.2 (0.7)	2.0	3.1 (0.8)	3.3
MACL(h)	2.7 (0.5)	2.8	3.3 (0.6)	3.5
DAS	16.4 (2.9)	16.0	12.6 (3.8)	12.5

This analysis was based on the first 21 patients who had started and completed the psychologic therapy. There were 16 women and 5 men with a mean age of 34.5 (standard deviation (*s*), 9.3) years and a range 24 to 53 years. The average time of avoidance of dental care was 8.6 years (*s*, 7.9), with a range of 2 to 34 years. Sixteen individuals were married or cohabitating. The educational status showed that 15 patients had a high school degree or less, and 6 patients reported higher academic education.

Instruments

A MACL was used to measure the patients' feelings and emotional reactions to a dental appointment. Originally, this scale consisted of 6 different dimensions of mood described by 71 adjectives (17). In the present investigations only 2 dimensions were used. These were the aspect of feeling pleasant/unpleasant in a dental situation (hedonic tone, MACL-h), and the degree of relaxation/tension (MACL-r). There are 16 adjectives that describe either of the 2 dimensions of mood (3, 11). The patients were asked to imagine being in a dental situation at a dental clinic and were instructed to rate their feelings in that situation. Each adjective is rated on a scale from 1 (strongly disagree) to 4 (strongly agree). For each of the MACL dimensions an average item score is calculated, ranging from one to four, where one is a strongly negative and four a highly positive level of mood. Normative mean values in a Swedish population have been reported to 3.1 for hedonic tone and 3.0 for degree of relaxation (17). The MACL has been shown to distinguish between ordinary dental patients and dental phobic patients (11). Mean scores in MACL-h and MACL-r for ordinary dental patients have in previous studies been shown to be 2.8 and 2.7, respectively, whereas the equivalent score levels for dental phobics were 1.5 and 1.4 (11).

The Dental Anxiety Scale (DAS) was first presented in 1969 by Corah (18, 19), and since then the DAS has been the most most widely used test to measure dental anxiety. This scale has been applied foremost in epidemiologic surveys but also in clinical trials for screening purposes. In addition, it has been shown that the DAS can estimate overall treatment effects (1–8). However, owing to ceiling

Table 2. Correlation matrix of mood, dental anxiety, and treatment in relation to initial (pre-) and termination (post-) status*

		1	2	3	4	5	6
1	Pre-DAS						
2	Post-DAS	0.67					
3	Pre-MACL(r)	−0.68	−0.53				
4	Post-MACL(r)	−0.57	−0.73	0.53			
5	Pre-MACL(h)	−0.64	−0.45	0.75	0.42		
6	Post-MACL(h)	−0.46	−0.67	0.55	0.87	0.48	
7	Treatment	0.03	0.27	−0.04	−0.31	−0.01	−0.30

*DAS = Dental Anxiety Scale; MACL = Mood Adjective Checklist; (r) = degree of relaxation dimension; (h) = degree of pleasantness dimension.

effects, the DAS is less valuable in differentiating among patients with extreme dental fear (3). Moreover, the DAS does not directly measure dimensions of a person's beliefs, attitudes, or emotions to dentists and dentistry. The DAS comprises four multiple-choice questions dealing with the individual's reactions and expectations of going to and being treated by a dentist. Each question consists of five response alternatives, ranging from 1 (no anxiety) to five (extreme anxiety). The sum of the test ranges from 4 to 20, and population-normative mean scores have been reported in several studies to be between 8 and 9 (3, 4). A DAS score of 15 or higher is judged to indicate a high dental anxiety (4, 14, 19). The reliability and validity of the DAS test has been shown in several previous studies (11, 14), and this instrument has earlier been translated into a Swedish version from the original scale (11).

Statistical analysis

To analyze and reveal mood improvement or decline and their correlates over time during the psychologic treatment, a hierarchic linear models (HLM) approach was used (9). Hierarchical linear models constitute a multivariate and multilevel analysis tool that is suitable also for studying longitudinal changes in a repeated measurement design. HLM is both conceptual and flexible and provides separate models for the various levels. In this study the analyses are performed at two levels. Level 1 formulates a model that represents each patient's change during the treatment period (within-patient level), and level 2 presents differences between patients in growth rates of the outcome variable and in addition, the impact of different covariates. The covariates of these analyses included DAS and treatment modalities.

Preliminary analyses of both mood dimensions, such as plots of MACL(r) and MACL(h), suggested that the growth curve followed a linear course (Fig. 1). The first model consisted of the within-patient change in mood and no predictors (unconditional model). Such a model shows the average improvement (or deterioration) of the patient sample and also how the patients vary in their growth rate during the treatment. Moreover, the variability of pretreatment status is also assessed in this first model. The subsequent, conditional models, comprise covariate(s) to capture differences in various patient and treatment characteristics which may be included as predictors to reach a higher degree of explanation for possible reasons of individual differences in mood changes over time.

In addition to the HLM analyses, simple descriptive statistics were calculated. Methods used included the Wilcoxon signed ranks test, the Mann–Whitney test, and the Spearman correlation coefficient.

Results

Table 1 shows the descriptive statistics of DAS and MACL for both the initial and termination status. The analysis showed that the total group changed the mean scores statistically significantly in the mood and dental anxiety measures. The mean DAS score at base line was 16.4 and at termination 12.6, which resulted in a statistically significant difference (Wilcoxon $z = -3.1$, $P = 0.002$). Similar results were found for MACL(r) and MACL(h) with Wilcoxon $z = -3.7$, $P < 0.001$, and Wilcoxon $z = -2.7$, $P = 0.007$, respectively. When comparing the two different treatment groups, no statistically significant differences were found, either at the therapy onset or at the termination.

The correlation matrix in Table 2 shows negative moderate to high correlation coefficients between DAS scores and mood, both at the start and at the end of therapy. Spearman's rho varied between −0.45 and −0.73, which indicated significant associations among

Table 3. Estimated mean growth variables and variance components for the degree of relaxation dimension (r) on the Mood Adjective Checklist (MACL(r)) in the unconditional model*

Fixed effect	Coefficient	$s_{\bar{x}}$	t Value
Mean initial status	2.1	0.16	13.2
Mean growth rate	0.14	0.02	6.1
Random effect	**Variance components (s)**		**Chi-square**
Initial status	0.36 (0.60)		66.0
Growth rate	0.004 (0.06)		33.4
Level 1 error	0.25 (0.5)		

*$s_{\bar{x}}$ = Standard error; s = standard deviation.

Table 4. Estimated mean growth factors and variance components for the degree of pleasantness dimension (h) on the Mood Adjective Checklist (MACL(h)) in the unconditional model

Fixed effect	Coefficient	$s_{\bar{x}}$	*t* Value
Mean initial status	2.7	0.13	20.9
Mean growth rate	0.09	0.02	4.0
Random effect	Variance component (*s*)		Chi-square
Initial status	0.28 (0.53)		86.1
Growth rate	0.005 (0.07)		40.1
Level 1 error	0.19 (0.44)		

*$s_{\bar{x}}$ = Standard error; *s* = standard deviation.

Table 5. Estimated mean growth variables and variance components for the degree of relaxation dimension (r) on the Mood Adjective Checklist (MACL(r)) in the conditional model that included the predictor variables Dental Anxiety Scale (DAS) and treatment*

Fixed effect	Coefficient	$s_{\bar{x}}$	*t* Value
Model for initial status			
Base	4.0	1.2	3.3
DAS	−0.12	0.06	−1.95
Treatment	0.09	0.31	0.3
Model for growth rate			
Base	0.37	0.17	2.2
DAS	−0.007	0.009	−0.8
Treatment	−0.07	0.04	−1.6
Random effect	Variance component (*s*)		Chi-square
Initial status	0.32 (0.57)		53.7
Growth rate	0.004 (0.06)		28.9
Level 1 error	0.25 (0.5)		

*$s_{\bar{x}}$ = Standard error; *s* = standard deviation.

the variables except for MACL(h)/base line and DAS/termination, and MACL(h)/termination and DAS/base line. Treatment did not correlate statistically significantly with any of the other measures.

As can be seen in Fig. 1 there was a clear improvement in MACL(r) over time; median scores showed 2.00, 2.25, 2.63, 2.63, 2.75, 2.94, 3.38, and 3.31 during the course of the 8 sessions. A similar significantly positive pattern of increase was found for MACL(h) during therapy (2.75, 2.88, 3.25, 3.50, 3.00, 3.19, 3.50, and 3.50), except between session 4 and 5 (no statistically significant difference).

In Tables 3–5 the HLM models are presented. The first two models represent the unconditional models in which no predictors were included, and Table 5 shows the conditional model, in which DAS and treatment were analyzed in the final model with MACL(r) as the outcome variable. The mean improvement in the relaxation dimension of mood is shown in Table 3. The mean intercept (2.1) and the mean growth rate (0.14) had high *t* values: 13.2 and 6.1, respectively. The interpretation of this may be that both variables were necessary to describe the mean growth trajectory. The mean initial status was the same as presented in Table 1 for MACL(r), but in addition the HLM analysis produced an estimate of the variance of individual intercept status and a test statistic (chi-square). The initial status showed a variance component of 0.36 and a chi-square statistic of 66.0, which indicated that the patients varied significantly in their mood measures at the entry to the psychologic treatment. Moreover, the mean growth rate was 0.14, which means that the patients, on average, increased their MACL(r) scores 0.14 per therapy session during this study. For this factor the variance component was 0.004 with a chi-square statistic of 33.4, thus concluding that there was a significant variation in their MACL(r) improvement rates. The interpretation of this result may be that a patient whose growth in mood is one standard deviation above average is expected to increase mood at a rate of $0.14 + 0.06 = 0.20$ per week in therapy. In Table 4 the unconditional model for MACL(h) is shown, and similar results were found here as with MACL(r). The random effect of growth thus implied that a patient with a growth 1 *s* above the average would gain 1.12 MACL(h) score over the course of a 7-week treatment, whereas an average patient would improve 0.63 in MACL(h) score. The HLM analyses also provide an estimate of the correlation between change and initial status, which for MACL(r) and MACL(h) were −0.30 and −0.20, respectively. This means that a patient who reported lower mood at the start of therapy tended to gain at a somewhat faster rate. Such interpretations cannot be inferred from a simple bivariate correlation analysis of base-line to termination scores. Inspection of the correlation matrix in Table 2 illustrates this fact.

The results of the introduction of two predictors, treatment and DAS, in the MACL(r) model is shown in Table 5. The treatment variable is dichotomous with 1 and 2 indicating cognitive and relaxation-oriented therapy, respectively. DAS is a continuous variable for the measure of dental anxiety level. Neither DAS nor treatment was strongly related to initial status or growth rate as shown by the *t* values in the fixed-effect model. This conditional model also concluded that there was significant variation in the patients' scores at the entry to therapy and the growth rate. Another measure of a possible improvement of the model is the proportion of variance explained between the unconditional and conditional model. The initial status and growth rate showed 11% and less than 2% in added explained variance, respectively, for the conditional model. It can thus be concluded that DAS and treatment as predictors did not explain the initial status and growth trajectory of MACL(r). The conditional model for MACL(h) was similar to that for MACL(r) (data not shown).

Discussion

The study and interpretation of individual change in epidemiologic surveys and clinical trials in medicine and

odontology is of utmost importance. Questions to be asked and, we hope, be solved in such designs may be whether the change in a biomarker is linear or non-linear (for example, exponential) over time, and can the analysis infer and predict the transformation and growth of, for example, a human tissue specific for such a biomarker to a developing cancer (20)? Commonly, the analyses have been based on only two measures, base line and termination, even though in many cases multiple time-points have been collected. This means that important information has not been analyzed, which may or may not alter the outcome results from a more simple analysis. There are at least two reasons for this problem: first, one can conclude that powerful methods to analyze longitudinal data have been developed during the past decade, and second, the knowledge and ability to analyze data by means of these often statistically complicated methods have been hard to acquire. Today there are several statistical methods to apply, more or less conceptually adapted for a less advanced researcher. Hierarchical linear models, generalized linear models, and structural equation modeling with latent variables are but a few methods that are able to handle multivariate, multilevel, and repeated measurements. These statistical methods are available through different statistical computer programs, of which the HLM program is the one used in this study. HLM does not solve all of the problems one may face when designing a study or analyzing data, since it is based on the assumptions of linearity and normality and uses a simple regression structure with a single dependent variable (9). However, for the purposes in this study, to analyze the individual growth during a treatment intervention of an outcome measure such as mood and possible covariates, this technique is more than sufficient.

The aims of this study were to apply HLM to evaluate the changes in mood in patients during psychologic therapy for their dental fear. To our knowledge, such an analysis of repeated measurements has not been performed elsewhere within the field of behavioral dentistry. Mood has been used as an outcome measure in dental fear research as reported in several studies (4–6, 10–16). MACL captures a patient's feelings of relaxation/tension and pleasantness/unpleasantness in relation to a dental situation that they imagine or watch on a video. Sixteen adjectives describe these two dimensions, and previous studies have shown that MACL correlated with dental anxiety and, in addition, reflected individual differences in treatment response (3, 10, 12, 15). The patients in this study answered the MACL questionnaire in conjunction with each therapy session, which made it possible to monitor each patient's improvement in the two MACL dimensions. The mean or median trajectory over the treatment course (Fig. 1) offered a visual inspection of the growth rate and whether it was linear or non-linear. HLM can also handle non-linear growth curves, either by fitting an appropriate polynomial equation or by breaking up the curvilinear growth trajectory into separate linear components. In this analysis the growth trajectory was considered to be linear. The two unconditional models (Tables 3 and 4) showed first the fixed effects—that is, the mean initial status and the mean growth rate during the therapy. Hereby the improvement in mood per week was estimated for the total group of patients regardless of type of treatment. In addition, the significant t values indicated that both factors were necessary to describe the mean growth rate. Secondly, the random effects showed that the patients varied significantly both in their mood scores at the entry to therapy and in their rate of mood improvement. The additional univariate analyses showed that mood scores increased statistically significantly from base line to termination of the treatment, meaning that the patients felt more relaxed and experienced the dental situation as more pleasant as compared with before treatment. This result is in agreement with several previous studies (3, 5–8, 15, 16). The conditional model for MACL(r) and MACL(h) (data not shown) with the predictors DAS and treatment did not contribute any significant explanation as compared with the initial models. This result was further clarified since the contribution of the variance explained by the conditional model was very low. However, DAS had a close to significant t value (-1.95), indicating that patients with a higher DAS level had lower MACL(r) scores at the entry to treatment.

The sample size in this study was small, and the result should be interpreted with caution. Both the error variance and the type-II error are affected by the limited number of subjects. The HLM analyses, however, do partition the total variance into error (denoted as level-1 error in the tables) and true variance, thus enabling the researcher to interpret the amount of error variance (9).

The next step in this research project will be to model the growth trajectory of mood during dental treatment and at follow-up when the patients' future dental care will be outside the DFRTC and with a general practitioner. Previous investigations have indicated that there may be a decrease in mean/median mood scores after psychologic treatment; an extended longitudinal analysis may therefore yield a non-linear course of the growth rate (8, 15).

In conclusion, these hierarchical linear models have shown that the positive mood changes during psychologic treatment for dental fear were statistically significant. Moreover, the mean improvement in mood scores per week and therapy session was estimated, which not only implies a significant improvement per se but also the effectiveness of the psychologic treatment. In addition, this study illustrates a powerful method for analyzing a longitudinal clinical trial design with repeated measurements.

Acknowledgements.—This study was supported by The Swedish Medical Research Council, projects 11335 and 11259; The Fulbright Commission; The Swedish Institute; and The National Institute of Dental Research, NIH, USA, grant DE 08296. Special thanks go to Professor Michael Seltzer, Graduate School of Education, UCLA.

References

1. Carlsson SG, Linde A, Öhman A. Reduction of tension in fearful dental patients. J Am Dent Assoc 1980;101:638–41.
2. Milgrom P, Weinstein P, Kleinknecht R, Getz T. Treating fearful dental patients. 2nd ed. Seattle (WA): University of Washington; 1995.
3. Berggren U. Dental fear and avoidance. A study of etiology, consequences and treatment [thesis]. Göteborg: Göteborg University; 1984.
4. Berggren U. Reduction of fear and anxiety in adult fearful patients. Int Dent J 1987;37:127–36.
5. Moore R. The phenomenon of dental fear [thesis]. Århus, Denmark: Royal Dental College; 1991.
6. Hakeberg M. Dental anxiety and health. A prevalence study and assessment of treatment outcomes [thesis]. Göteborg: Göteborg University; 1992.
7. Berggren U. Long-term effects of two different treatments for dental fear and avoidance. J Dent Res 1986;65:874–6.
8. Hakeberg M, Berggren U, Carlsson SG. A 10-year follow-up of patients treated for dental fear. Scand J Dent Res 1990;98:53–9.
9. Bryk AS, Raudenbush SW. Hierarchical linear models. Newbury Park (CA): Sage Publications Inc.; 1992.
10. Harrison JA. Methodological research in process and outcome studies: psychophysiology, systematic desensitization, and dental fear [thesis]. Göteborg: Göteborg University; 1983.
11. Berggren U, Carlsson SG. Psychometric measures of dental fear. Community Dent Oral Epidemiol 1984;12:319–24.
12. Harrison JA, Berggren U, Carlsson SG. Research in clinical process and outcome methodology: psychophysiology, systematic desensitization, and dental fear. J Behav Ther Exp Psychiatr 1985;16:201–9.
13. Berggren U, Meynert G. Dental fear and avoidance: causes, symptoms and consequences. J Am Dent Assoc 1984;109:247–51.
14. Moore R, Berggren U, Carlsson SG. Reliability and clinical usefulness of psychometric measures in a self-referred populations of odontophobics. Community Oral Dent Epidemiol 1991; 19:347–51.
15. Moore R, Berggren U, Carlsson SG, Brødsgaard I. Generalization of effects of dental fear treatment in a self-referred population of odontophobics. J Behav Ther Exp Psychiatry 1991;22: 243–53.
16. Hakeberg M, Berggren U, Carlsson SG, Gröndahl HG. Long-term effects on dental care behavior and dental health after treatments for dental fear. Anesth Prog 1993;40:72–7.
17. Sjöberg L, Svensson E, Persson L-O. The measurement of mood. Scand J Psychol 1979;20:1–18.
18. Corah NL. Development of a dental anxiety scale. J Dent Res 1969;48:596.
19. Corah NL, Gale EN, Illig SJ. Assessment of a Dental Anxiety Scale. J Am Dent Assoc 1978;97:816–9.
20. Pearson JD, Morrell CH, Landis PK, Carter HB, Brant LJ. Mixed-effects regression models for studying the natural history of prostate disease. Stat Med 1994;13:587–601.

Received for publication 13 May 1997
Accepted 18 June 1997