

Negative dental experiences and their relationship to dental anxiety

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Although negative dental experiences are often cited as the major factor in the development of dental anxiety, very few studies have provided data on their prevalence. The studies that are available used limited samples from which it is not possible to generalise, or confined their enquiries to painful experiences only. In this paper data are provided on negative dental experiences and their relationship to dental anxiety obtained from a large, random sample of the general population. Just over three-quarters reported what are termed as direct negative experiences: 71 per cent had had experiences that were painful, 23 per cent experiences that were frightening and 9 per cent experiences that were embarrassing. Such experiences were not confined to childhood. For 23 per cent, the first experience of this kind happened during adolescence and for 40 per cent in adulthood. The relationship between these experiences and dental anxiety was strong. Subjects reporting all three types of experience were 22.4 times at risk of being dentally anxious than subjects reporting none of them. The data suggested that the nature of these unpleasant experiences was more important than the age at which they occurred in predicting dental anxiety. One third of dentally anxious subjects reported a negative response experience in the form of feeling faint, fainting or having a panic attack while at the dentist. Further research using more appropriate methods is needed to clarify the role of dental experiences in the genesis of dental anxiety.

Key words: aversive experiences, dental anxiety, pain

Introduction

Dental anxiety is one of the most common fears and phobias (Agras *et al.*, 1969; Fiset *et al.*, 1989). It is a major issue with respect to the provision of dental care, leading to irregular attendance, delay in seeking treatment or its avoidance altogether (Liddell and May, 1984; Schuurs *et al.*, 1984; Woolgrove and Cumberbatch, 1986; Milgrom *et al.*, 1988; Locker and Liddell, 1991). It has also been shown that dentally anxious individuals are more dissatisfied with dental care when they do attend (Locker and Liddell, *op. cit.*) and have poorer oral health than their non-anxious counterparts (Berggren and Meynert, 1984; Cohen, 1985; Locker and Liddell, 1992).

Early controversies and contradictions in studies concerning the aetiology of dental anxiety were partially reconciled by Weiner and Sheehan (1990) who proposed a two-fold classification of dentally anxious subjects into an endogenous (internal) group and an exogenous (external) group. In the former, dental anxiety is part of a more generalised anxiety disorder involving multiple phobias and psychiatric diagnoses. Many dentally anxious subjects exhibit additional severe fears, mood disorders or psychiatric problems (McNeil and Berryman, 1989; Berggren, 1992; Roy-Byrne *et al.*, 1994). In the latter, dental anxiety consists of a simple conditioned phobia that emerges as a result of direct or vicarious negative dental experiences. Evidence to support this classical conditioning model comes from studies showing that substantially more dentally anxious individuals can recall such experiences than non-anxious individu-

als (Lautch, 1971; Bernstein *et al.*, 1979, Kleinknecht *et al.*, 1973; Ost and Hugdahl, 1985; Moore *et al.*, 1991).

This body of evidence confirms that there are diagnostic subtypes of dental anxiety which differ in terms of causes and manifestations. Milgrom *et al.* (1985) have proposed a diagnostic classification consisting of four distinct sub-types. While data on the distribution of these is limited, simple phobias based on prior unpleasant experiences appear to be the most common, constituting 80 per cent of the dentally anxious population (Fiset *et al.*, *op. cit.*; Moore *et al.*, *op. cit.*)

Given the significance accorded to unpleasant or traumatic dental experiences in the genesis of dental anxiety, very few studies have attempted to estimate the frequency with which these occur (Vassend, 1993) and the extent to which they are or are not linked to dental anxiety. Davey (1989) obtained data from a sample of students concerning painful dental experiences. Among a sub-group who had always been anxious about dental treatment, 93 per cent reported at least one painful treatment episode and 70 per cent reported multiple painful experiences. The comparable figures for those who had never been dentally anxious were 60 per cent and 7 per cent respectively. In support of the latent inhibition hypothesis, he also found that dentally anxious subjects experienced painful treatment earlier in their dental care history than those who were not anxious. Similar findings were reported by De Jongh *et al.* (1995) who also gathered data on traumatic as well as painful experiences. Again, both painful and traumatic treatments were more commonly reported by the anxious than the non-

anxious.

Both of these studies used student samples with numbers too small to give reliable estimates of the overall prevalence of aversive dental experiences. However, data presented by Vassend (op. cit.), based on large and representative samples of the adult population in Norway, indicated that negative dental experiences were common. At least one dental experience involving 'strong' pain was reported by 60 per cent and 20 per cent reported having felt unwell or nauseous while having treatment on two or more occasions.

One limitation of all of these studies is that they included a restricted range of negative experiences. Davey (op. cit.) focused on pain, De Jongh *et al.* (op. cit.) on pain and unspecified traumatic experiences and Vassend (op. cit.) on pain and feeling unwell. Moreover, none investigated the extent to which subjects experienced combinations of these experiences and the implications of multiple negative experiences for levels of dental anxiety.

Consequently, as part of a large-scale study of the epidemiology and psychology of dental anxiety in adults, data were collected in the current study on a wider range of negative experiences than has been reported previously. The aims of this paper then, are to 1) describe the prevalence of negative dental experiences, singly and in combination in a random sample drawn from the general population, 2) to explore their distribution according to age, gender and dental anxiety and, 3) to determine the strength of the association between these experiences and dental anxiety.

In the paper, aversive experiences have been classified into two types. The first has been termed direct negative experiences since they emanate from the treatment process itself or the dentist/patient relationship. These consist of experiences which are painful, frightening or embarrassing. The second has been termed negative response experiences since they consist of people's emotional or physiological responses to aspects of treatment or dental care delivery. These include problems such as feeling faint, fainting and having a panic attack. These experiences were separated since direct negative experiences are more likely to be causes of dental anxiety while negative response experiences are more likely to be consequences of anxiety.

Material and method

The target population for the study was all persons aged 18 years and over living in the City of Etobicoke, one of five municipalities which comprise Metropolitan Toronto. The sampling frame was the list of voters covering the city. Since this list is compiled using a household enumeration rather than a voter registration approach, it has been estimated that the list contains the names and addresses of 97 per cent of persons eligible to vote.

A two-stage random start systematic sampling procedure was used in which primary sampling units were polling sub-divisions and secondary units were named persons. The sampling fractions were selected to give a final sample of 6360 subjects.

Data were collected by means of a four wave-mail

survey. This approach was chosen partly because of costs and partly because evidence suggests that data on sensitive issues such as fear of the dentist are more accurate when collected using self-complete questionnaires rather than methods based on personal contact (Dillman, 1978). The questionnaire used in the study was comprehensive and included sections on unpleasant experiences during dental treatment, dental anxiety, dental visiting behaviours, attitudes towards dentists and fear of pain. A complete version of the questionnaire was used in the first and third mailings (the second consisted of a reminder post-card), while the fourth mailing contained a shortened version of the questionnaire in the hope of stimulating a response from hard-core non-responders (Locker and Grushka, 1988).

Data on negative experiences were collected by two sets of three questions. Subjects were asked if they had ever had an experience at the dentist which was painful, frightening or embarrassing. Those who reported one or more of these experiences were asked to indicate the age at which this first occurred. Then, questions were asked on feeling faint, fainting or having a panic attack while at the dentist.

Dental anxiety was measured using Corah's Dental Anxiety Scale (Corah, 1969), a widely used four-item measure giving rise to scores ranging from 4 to 20. Scores of 13 and above are usually taken to indicate an individual with problematic levels of dental anxiety (Corah *et al.*, 1978).

Data analysis consisted of descriptive statistics and bivariate analyses using gender and age as independent variables.

The chi-square test was used to determine the significance of differences between groups. Because of the large sample size significant differences need to be interpreted carefully and take account of the magnitude of the differences as well as the associated *P* values. Although the study was cross-sectional, it approximated a case-control study in which cases (dentally anxious subjects) and controls (non-anxious subjects), selected from similar sources, were compared in terms of their prior exposure to risk factors (negative experiences). Consequently, *t* tests, chi square analysis and odds ratios with their 95 per cent confidence intervals were used to assess the relationship between negative experiences and dental anxiety.

Results

Response and characteristics of subjects

Of 6360 mailed questionnaires, 1254 were returned by the Post Office and a further 45 were returned because the subject had died, leaving 5061 subjects presumed to be alive, living at the listed address and, therefore, eligible for the study. Completed questionnaires were returned by 3055 persons, giving a response rate of 60.4 per cent. The long version of the questionnaire was completed by 2729 subjects and the short version by 326. This paper is based on data from the former.

Table 1 compares the socio-demographic characteristics of the subjects from whom complete data were obtained and the target population from which they were drawn. Data on the latter were obtained from the census

Table 1. Characteristics of study subjects and target population.

	Study subjects (n=2729)	Target population (n=256,390)
Gender		
Males	47.8	42.9
Females	52.2	57.1
Age		
18–29 years	12.1	22.1
30–39 years	18.4	21.1
40–49 years	17.9	16.1
50–59 years	16.3	14.4
60–74 years	17.8	19.6
75 years and over	3.3	6.8
Education		
Less than high school	6.5	11.8
Completed high school	31.0	38.8
Post-secondary	36.5	34.9
University	25.0	15.5

of 1991. While study subjects were broadly representative of the target population, males, persons less than 30 years of age and those with lower levels of educational attainment were under-sampled.

The mean DAS score of study subjects was 8.3 (SD=3.3) and 10.9 per cent had a score of 13 and over, indicating high levels of dental anxiety. Women were more likely to be dentally anxious than men (13.7 per cent vs 7.3 per cent; $P<0.0001$) while the per cent dentally anxious showed something like an inverted U-shaped relationship with age, as follows: 18–29 years, 10.1 per cent; 30–39 years, 13.3 per cent; 50–69 years, 9.5 per cent; 70 years and over, 7.5 per cent ($P<0.01$).

The majority of subjects, 92.0 per cent, reported having a regular source of dental care and 69.8 per cent made regular preventive dental visits. Invasive dental treatments such as fillings, extractions, root canal work

and crowns had been received by 88.6 per cent. Only 4.5 per cent of study subjects were edentulous.

Prevalence of direct negative dental experiences

Just over three-quarters of the respondents reported direct negative experiences. Painful experiences were reported by 71.3 per cent, frightening experiences by 23.0 per cent and embarrassing experiences by 8.9 per cent. Two or more of these types of experiences were reported by 21.5 per cent and all three by 4.3 per cent (Table 2).

Women were more likely than men (27.9 per cent vs 16.5 per cent; $P<0.0001$) to have been frightened while undergoing dental treatment but there were no differences in the proportions experiencing pain or being embarrassed. In addition, women were more likely than men to report multiple types of negative experiences. Table 2 also shows that those aged 70 years and over were less likely than younger age groups to report negative experiences and substantially less likely to report multiple experiences, but differences between groups under the age of 70 years were not marked.

The distribution of subjects with respect to combinations of experiences is also shown in Table 2. Overall, half the study subjects reported experiencing pain but no other aversive experiences. One-in-seven had both painful and frightening experiences. Women were more likely than men to report a combination of painful and frightening experiences (17.5 per cent vs 10.0 per cent) but the old were less likely than the young to report this combination (11.0 per cent vs 16.6 per cent).

Age at first negative experience

Among those reporting direct negative experiences, 37.2 per cent said that these first happened as a child, 22.7 per cent as an adolescent and 39.9 per cent as an adult. Gender differences, although significant were relatively small, with a slight excess of women remembering their first such experience in childhood (Table 3). Differences

Table 2. Per cent reporting direct negative experiences: all subjects and by age and gender.

	Gender			Age (years)			
	All	Male	Female	18–29	30–49	50–69	70+
Negative experience							
Painful	71.3	71.3	71.3	71.4	75.7	72.2	57.1*
Frightening	23.0	16.5	27.9**	24.9	27.0	21.3	14.6*
Embarrassing	8.9	7.8	9.8	11.7	12.0	6.4	4.6*
Number of types of experiences							
None	22.5	24.1	21.2*	23.9	18.5	21.7	33.4*
One	56.1	59.8	53.3	49.9	55.5	59.4	57.8
Two	17.2	12.5	20.9	20.7	20.0	16.4	7.9
Three	4.3	3.6	4.7	5.6	6.6	2.6	0.9
Combinations of experiences							
None	22.5	24.1	21.2*	23.9	18.5	21.7	33.4*
Pain only	50.2	55.5	46.1	45.4	49.5	53.4	48.6
Frightening only	4.2	2.6	5.4	3.2	3.5	4.2	7.3
Embarrassing only	1.7	1.7	1.8	1.3	1.9	1.7	1.8
Painful and frightening	14.2	10.0	17.5	15.9	16.5	14.3	6.1
Painful and embarrassing	2.7	2.2	3.3	4.5	3.1	1.8	1.5
Frightening and embarrassing	0.3	0.3	0.3	0.3	0.4	0.2	0.3
All three	4.3	3.6	4.7	5.6	6.6	2.6	0.9

* $P<0.0001$ ** $P<0.001$

Table 3. Age at which first negative direct experience occurred (%).

Age	Child <12 years	Adolescent 13-17 years	Adult 18 years+
All	37.2	22.7	39.9
Males	34.3	26.8	38.9*
Females	39.5	20.0	40.5
18-29 years	43.4	36.8	19.8**
30-49 years	44.2	21.4	34.4
50-69 years	32.5	21.4	46.1
70 year and over	23.1	15.0	61.9

* $P < 0.001$ ** $P < 0.0001$

between age groups were more substantial. Younger subjects were more likely to locate their first negative experience in childhood while older subjects were more likely to claim that such experiences first occurred when they were an adult.

Negative dental experiences and dental anxiety

Table 4 summarises the analysis of the relationships between negative dental experiences and dental anxiety. Mean DAS scores and proportions with scores of 13 or above varied significantly according to exposure to aversive experiences. Only 2.7 per cent of those reporting no direct negative experiences were dentally anxious compared with 38.1 per cent of those reporting all three ($P < 0.0001$).

Variations in the proportions dentally anxious according to combinations of experiences suggest that

frightening experiences and painful experiences in combination with others are the strongest predictors of anxiety. This is indicated by the associated odds ratios. Those with painful and frightening experiences had almost ten times the risk of being dentally anxious than those with no such experiences. The odds ratio for all three was 22.4.

Further analyses were undertaken to determine whether or not the age at which a negative experience first occurred influenced the probability of being dentally anxious and whether or not this was also influenced by specific experiences occurring at specific ages. Age appeared to have only a weak effect. Among those reporting their first aversive experience as a child, 15.6 per cent were dentally anxious. For those with a first experience in adulthood, 11.1 per cent were dentally anxious ($P < 0.05$). When these groups were compared with those reporting no negative experiences, the odds ratio for the former was 6.7 and for the latter, 4.5.

The percentages dentally anxious according to the nature of the negative experience and the age at which the first negative experience occurred are shown in Table 5. The columns reveal that the nature of the experience had a significant effect on the probability of dental anxiety, irrespective of age at the time of the first experience. However, the age at which the experiences first occurred had no significant effect on the probability of dental anxiety. This was confirmed by a logistic regression analysis which showed that, after controlling for the age at which the first negative experience occurred, the strength of the relationship between negative experiences and dental anxiety was virtually

Table 4. Relationship between negative direct experiences and dental anxiety.

	Mean DAS score	% dentally anxious	Odds ratio	95% CI
Negative experience				
Painful				
Yes	8.7*	13.4**	2.6	1.9-3.8
No	7.2	5.4	1.0	
Frightening				
Yes	10.2*	23.5**	4.0	3.1-5.2
No	7.7	7.1	1.0	-
Embarrassing				
Yes	10.2*	25.7**	3.3	2.4-4.7
No	8.1	9.4	1.0	-
Number of types of experience				
None	6.7**	2.7**	1.0	
One	8.2	9.1	3.7	2.1-6.4
Two	9.9	20.4	9.4	5.3-16.8
Three	11.7	38.1	22.4	11.5-43.9
Combination of experiences				
None	6.7**	2.7**	1.0	-
Painful only	8.1	8.5	3.4	1.9-5.9
Frightening only	9.4	17.0	7.4	3.5-15.8
Embarrassing only	7.8	9.1	3.6	0.9-13.4
Painful and frightening	10.0	21.1	9.7	5.4-17.6
Painful and embarrassing	9.4	16.7	7.3	3.1-17.2
Frightening and embarrassing	9.4	-	-	-
All three	11.7	38.1	22.4	11.5-43.9

* $P < 0.001$; ** $P < 0.0001$; - too few subjects for analysis; OR - Odds ratio; 95% CI - 95% confidence interval

Table 5. Per cent dentally anxious by negative direct experiences and age at first negative experience.

	<i>Child</i>	<i>Adolescent</i>	<i>Adult</i>	<i>P</i>
Combination of experiences:				
Painful only	9.4	8.1	7.8	ns
Frightening only	13.6	10.5	22.4	ns
Embarrassing only	—	—	—	—
Painful and frightening	21.1	21.6	20.9	ns
Painful and embarrassing	21.7	20.0	10.3	ns
Frightening and embarrassing	—	—	—	—
All three	42.3	42.9	28.1	ns
<i>P</i>	<0.0001	<0.0001	<0.000	

— too few subjects for calculation of rates

Table 6. Negative response experiences by dental anxiety status (%).

	<i>Anxious</i>	<i>Not anxious</i>	<i>P</i>
Feeling faint	40.4	11.5	<0.0001
Fainting	7.0	2.2	<0.0001
Panic attack	34.4	4.1	<0.0001
Number of types of experiences			
None	46.9	85.3	<0.0001
One	40.3	13.0	
Two	11.7	1.6	
Three	1.0	0.2	

P: *P* values obtained from chi square tests

unchanged. Subjects reporting all three types of experience had 19.7 times the risk of being dentally anxious as those reporting none.

Negative response experiences

These were much less common than the direct negative experiences, with only 9.2 per cent of subjects reporting one or more. Feeling faint was reported by 14.4 per cent, actually fainting by 2.7 per cent and a panic attack while at the dentist by 7.5 per cent.

As anticipated there were major differences in the reporting of these experiences according to dental anxiety status (Table 6). Two-fifths of the dentally anxious group had felt faint while having dental treatment and slightly more than one-third had had a panic attack. Moreover, 12.7 per cent of the anxious reported two or more of these experiences compared to 1.8 per cent for the non-anxious.

Discussion

Although the response to the study was less than ideal, recent experience suggests that it approaches the maximum that can be achieved in populations living in metropolitan communities. One reason for this is that communities such as Metropolitan Toronto are multicultural, with 45 per cent of the population having been born outside Canada. Moreover, illiteracy rates are high and have been estimated to be in excess of 30 per cent. This should be taken into account in interpreting the findings of the study.

The results of the paper confirm the findings of

Vassend (op. cit.) in that unpleasant dental experiences were common among this sample of adults. More than three-quarters had direct negative experiences involving pain, being frightened or being embarrassed and almost one-in-ten had negative response experiences in the form of feeling faint, fainting or having a panic attack. Differences in the prevalence of these two types of experience lends some support to the view of the former being most likely causative of dental anxiety and the latter most probably consequences of dental anxiety. However, some phobias develop following an unanticipated panic attack when in contact with some stimulus so that the role of these response experiences may be more complex than this simple typology represents.

The results of the study also confirm that there is a strong relationship between dental anxiety and direct negative experiences. This has been reported by a number of investigators, most recently by Davey (op. cit.) and De Jongh *et al.* (op. cit.). An attempt was made to take this issue one step further by including experiences in addition to pain in the study, examining combinations of experiences and using odds ratios to provide a numerical estimate of the strength of their relationship with dental anxiety.

The results suggest that while painful experiences are predictive of dental anxiety, other types of experience, alone or in combination with pain show a stronger relationship. For example, 8.5 per cent of those reporting painful experiences only were dentally anxious compared with 17.0 per cent of those reporting frightening experiences only. This is also reflected in the associated odds ratios which increase in dose-response fashion with the number of types of negative experience. It is noteworthy that subjects who reported all three types of negative dental experience had 22.4 times the risk of being dentally anxious as those with no negative experiences. This odds ratio is larger than most encountered in epidemiological research and matches that frequently found for smoking and lung cancer.

The data also suggest that painful and frightening experiences are not confined to, or predominantly a feature of, childhood. Here, reports of the first negative experience were almost equally likely to place them in adolescence and adulthood as childhood. There was also an indication that the nature of the aversive experiences encountered were much more important than the age at which they occurred. This may partly explain why some

15 per cent of dentally anxious subjects appear to have acquired their anxiety in adulthood (Milgrom *et al.*, 1988). This is an important finding which deserves further study.

Does this mean that negative experiences of this type cause dental anxiety? While the results are consistent with a causal role they need to be interpreted with caution. Although the study was cross-sectional in design, it encompassed the key features of a retrospective or case-control study. However, methodological problems remain relating to the temporal sequence of events necessary to assign a causal role. That is, there can be no certainty that these events preceded the onset of anxiety and it is equally plausible that the causal direction is in the opposite direction. That is, dentally anxious subjects may be more likely than the non-anxious to characterise their previous dental experiences as negative even if they did not play an aetiological role. Kent (1985) for example, found that dentally anxious subjects remembered more pain three months after dental treatment than was reported immediately after treatment. That is, their experiences appeared to be reconstructed over time to bring them in line with their anxieties about dental treatment and the expectation that it would be very painful. While it is entirely plausible that negative experiences are causative of certain sub-types of dental anxiety, most studies claiming such a role share the limitations of this one (Lindsay and Jackson, 1993).

This study also replicated previous findings in that not all subjects recalling negative experiences were dentally anxious (Davey, *op. cit.*; de Jongh *et al.*, *op. cit.*). Although data exist in support of the latent inhibition hypothesis, further research is needed into who becomes dentally anxious as a result of negative experiences, when and why. For example, Milgrom and

Weinstein (1993) have suggested that pain inflicted by a dentist who is perceived as caring is likely to have less effect than pain inflicted by a dentist who is perceived as cold and controlling. In addition, it is not clear that the latent inhibition hypothesis necessarily applies to those subjects who became dentally anxious in adolescence or adulthood and other explanations may be needed to account for the fact that some, but not all, with aversive experiences suffer onset at these ages.

Finally, the study revealed an intriguing relationship between age, dental anxiety and dental experience. The percent dentally anxious increased between the ages of 18–29 years and 30–49 years and then declined to an overall low among those aged 70 years and over. One explanation for this distribution is that it reflects both ageing and cohort effects. That is, among older adults, anxiety declines with ageing, partly because problems of chronic illness and disability loom larger than oral health issues. The relatively low rate in the youngest age group may be due to the emergence of a cohort which has had less invasive treatment, been subject to more advanced dental technology and received treatment at the hands of dentists more aware of patients' psychological needs. This explanation is undermined by the fact that younger adults are as likely as older age groups to report negative dental experiences, including pain. How to reconcile these apparently contradictory findings provides a useful avenue for further research and underlines the fact that dental anxiety is a complex phenomenon which is incompletely understood.

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References

- Agras, D., Sylvester, D. and Oliveau, D. (1969): The epidemiology of common fears and phobias. *Comprehensive Psychiatry* 10, 151–156.
- Berggren, U. (1992): General and specific fears in referred and self-referred adult patients with extreme dental anxiety. *Behaviour Research and Therapy* 30, 395–401.
- Berggren, U. and Meynert, G. (1984): Dental fear and avoidance: causes, symptoms and consequences. *Journal of the American Dental Association* 109, 247–251.
- Bernstein, D., Kleinknecht, R. and Alexander, L. (1979): Antecedents of dental fear. *Journal of Public Health Dentistry* 39, 113–124.
- Cohen, M. (1985): Dental anxiety and DMFS status: Association within a U.S. naval population versus differences between groups. *Community Dentistry and Oral Epidemiology* 13, 75–78.
- Corah, N. (1969): Development of a dental anxiety scale. *Journal of Dental Research* 48, 596.
- Corah, N., Gale, E. and Illig, S. (1978): Assessment of a dental anxiety scale. *Journal of the American Dental Association* 97, 816–819.
- Davey, G. (1989): Dental phobias and anxieties: Evidence for conditioning processes in the acquisition and modulation of a learned fear. *Behaviour Research and Therapy* 27, 51–58.
- de Jongh, A., Muris, P., Ter Horst, G. and Duyx, M. (1995): Acquisition and maintenance of dental anxiety: The role of conditioning experiences and cognitive factors. *Behaviour Research and Therapy* 33, 205–210.
- Dillman, D. (1978): *Mail and Telephone Surveys: The Total Design Method*. New York: John Wiley and Sons.
- Fiset, L., Milgrom, P., Weinstein, P. and Melnick, S. (1989): Common fears and their relationship to dental fear and utilization of the dentist. *Anesthesia Progress* 36, 258–264.
- Kent, G. (1985): Memory of dental pain. *Pain* 21, 187–194.
- Kleinknecht, R., Klepac, R. and Alexander, L. (1973): Origins and characteristics of fear of dentistry. *Journal of the American Dental Association* 20, 437–443.
- Lautch, H. (1971): Dental phobia. *British Journal of Psychiatry* 119, 151–158.
- Liddell, A. and May, B. (1984): Some characteristics of regular and irregular attenders for dental check-ups. *British Journal of Clinical Psychology* 23, 19–26.
- Lindsay, S. and Jackson, C. (1993): Fear of routine dental treatment in adults: Its nature and management. *Psychology and Health* 8, 135–154.
- Locker, D. and Grushka, M. (1988): Response trends and non-response bias in a mail survey of oral and facial pain. *Journal of Public Health Dentistry* 48, 20–25.
- Locker, D. and Liddell, A. (1991): Correlates of dental anxiety among older adults. *Journal of Dental Research* 70, 198–203.
- Locker, D. and Liddell, A. (1992): Clinical correlates of dental anxiety in older adults. *Community Dentistry and Oral Epidemiology* 20, 371–375.

- McNeil, D. and Berryman, M. (1989): Components of dental fear in adults. *Behaviour Research and Therapy* 27, 233-236.
- Milgrom, P., Weinstein, P. and Kleinknecht, R. (1985): *Treating fearful dental patients: a clinical handbook*. Reston Va: Reston Publishing Co.
- Milgrom, P., Fiset, L., Melnick, S. and Weinstein, P. (1988): The prevalence and practice management consequences of dental fear in a major U.S. city. *Journal of the American Dental Association* 116, 641-647.
- Milgrom, P. and Weinstein, P. (1993): Dental fears in general practice: New guidelines for assessment and treatment. *International Dental Journal* 43, 288-293.
- Moore, R., Brodsgaard, I. and Birn, H. (1991): Manifestations, acquisition and diagnostic categories of dental fear in a self-referred population. *Behaviour Research and Therapy* 29, 51-60.
- Ost, L. and Hugdahl, K. (1985): Acquisition of blood and dental phobia and anxiety response patterns in clinical patients. *Behaviour Research and Therapy* 23, 27-34.
- Roy-Byrne, P., Milgrom, P., Khoon-Mei, T., Weinstein, P. and Katon, W. (1994): Psychopathology and psychiatric diagnosis in subjects with dental phobia. *Journal of Anxiety Disorders* 8, 19-31.
- Schuurs, A., Duivenvoorden, H., Thoden van Velzen, S. and Verhage, F. (1984): Dental regularity, the parental family and regularity of dental attendance. *Community Dentistry and Oral Epidemiology* 12, 89-95.
- Vassend, O. (1993): Anxiety, pain and discomfort associated with dental treatment. *Behaviour Research and Therapy* 31, 659-666.
- Weiner, A. and Sheehan, D. (1990): Etiology of dental anxiety: Psychological trauma or CNS chemical imbalance? *General Dentistry* Jan-Feb, 39-43.
- Woolgrove, J. and Cumberbatch, G. (1986): Dental anxiety and the regularity of dental attendance. *Journal of Dentistry* 14, 209-213.