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SPECIFIC UPTAKE OF SOME DRUGS IN AMELOBLASTS AND DEVELOPING ENAMEL

by

LARS HAMMARSTRÖM

INTRODUCTION

The discovery that tetracycline was accumulated in developing skeletal tissues and that it might affect their development calls for an increased attention to drugs which accumulate in developing tissues.

When studying the distribution of a number of radioactively labelled drugs in adult mice it was found that some of them were concentrated in the dental hard tissues of the continuously growing incisors. Thus it was observed that some local anaesthetics (procaine-^{14}C, lidocaine-^{14}C, prilocaine-^{14}C), nicotine-^{14}C and 5,5-diphenylhydantoin-^{14}C were all accumulated in the developing enamel.

In order to get a better knowledge at which stage of enamel development this accumulation occurred and how long the drugs were retained, the distribution of two of them were studied in the developing molar teeth of young rats.

MATERIALS AND METHODS

Procaine-carboxyl-^{14}C HCI (specific activity 2.3 mc/mM) was dissolved in water and injected intravenously to three 10-day-old rats and one 15-day-old rat which were then killed by rapid freezing at 10 min., 60 min., 24 hours

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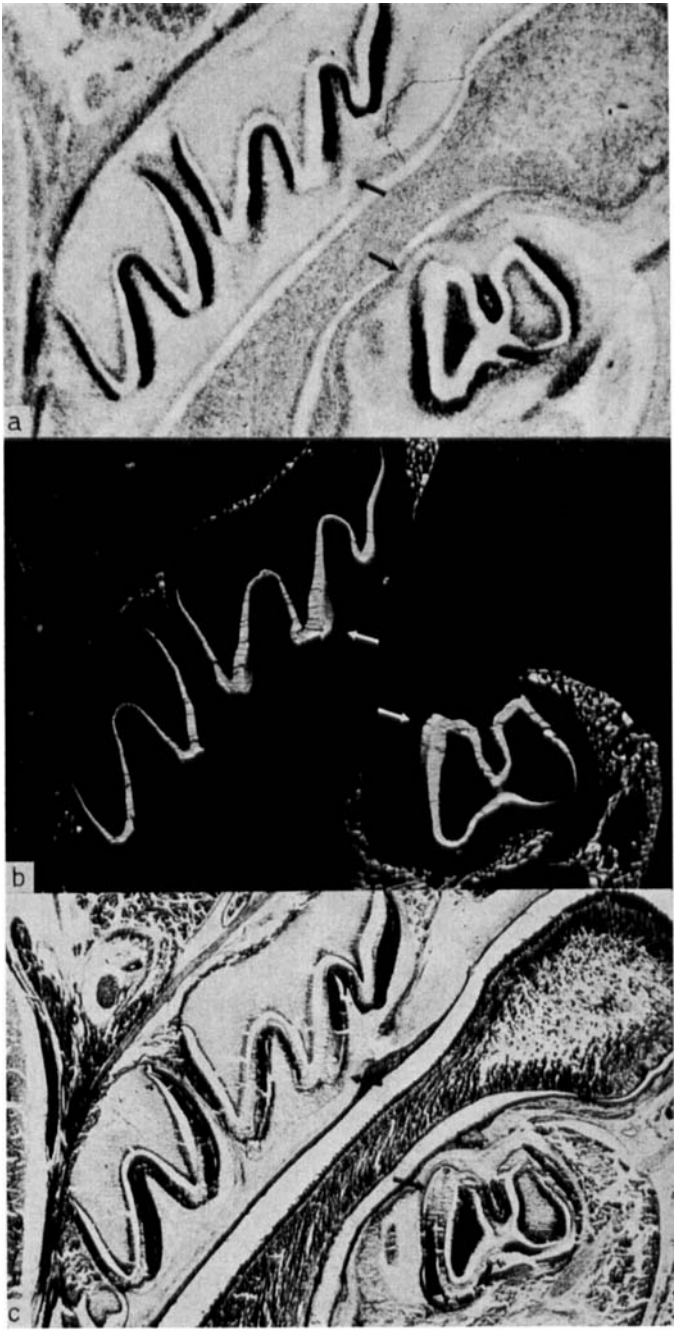
a
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and 5 min. respectively. Each animal was given 0.6 mg (5 μc) procaine-^{14}C. 5-5-diphenylhydantoin-4-^{14}C (specific activity 4.2 mc/mM) was dissolved in water to which was added 0.1 N NaOH and injected intravenously in a tail vein to three 9-day-old rats, which were killed after 5 min., 60 min. and 24 hours. Each animal was given 0.3 mg (5 μc). The labelled substances were obtained from New England Nuclear Corporation, Boston, Mass., USA. Freeze-sectioning and autoradiography according to *Ullberg* (1954, 1958) was then made. After exposure the sections were stained with hematoxylin and eosin, bromphenol blue or acid solochrome cyanine for proteins, as they are described by *Pearse* (1960). Some of the sections were microradiographed before staining.

RESULTS

The two drugs were specifically taken up in the tissues of the developing enamel but their distribution patterns were entirely different. Diphenylhydantoin-^{14}C was first taken up to a moderate concentration in the ameloblasts and in a superficial zone of the enamel. After 1 hour the radioactivity had reached a high concentration and penetrated the whole thickness of the non-mature enamel. It was accumulated in those areas, which showed a positive histochemical staining for proteins and where the mineral contents was lower (Fig. 1). It was retained longer in the enamel than in most other tissues in the body (Fig. 2).

Procaine-^{14}C rapidly appeared in the developing enamel. As early as 5 min. after an intravenous injection it had penetrated the whole thickness of the enamel. The concentration in the main part of the non-mature enamel was very low in comparison with the marked uptake which occurred in the whole width of a certain area of the enamel after matrix completion (Figs. 3, 4 and 5). In addition procaine-^{14}C was accumulated in those ameloblasts which had finished matrix production, as indicated by their reduced height (Figs.

Fig. 1 a. Detail of an autoradiograph showing the distribution of 5,5-diphenylhydantoin-4-^{14}C in the developing molar teeth of a 10-day-old rat at one hour after i.v. injection. Dark areas correspond to high concentration of radioactivity. Note the accumulation in the whole thickness of the non-mature enamel.

b. Microradiograph of the corresponding section. Light areas correspond to high mineral content.

c. Microphotograph of the corresponding section stained for proteins. Dark areas have a high protein content.

The arrows indicate the simultaneous decrease in radioactivity, increase in mineral content and decrease in protein content of the enamel.

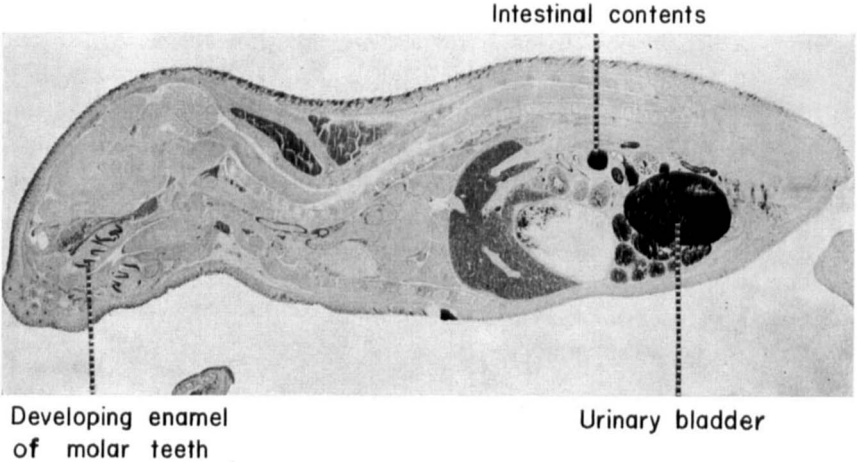

Fig. 2. A whole-body autoradiograph showing the distribution in an 11-day-old rat of 5,5-diphenylhydantoin at 1 day after intravenous injection. Dark areas correspond to high concentration of radioactivity. The developing enamel has about the highest concentration in the body.

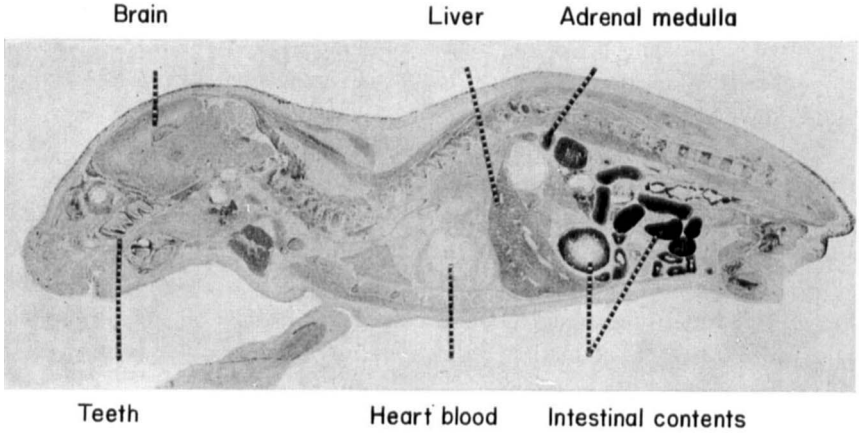

Fig. 3. Autoradiograph showing the distribution of procaine-^{14}C in a 10-day-old rat at 10 min. after i.v. injection. Dark areas correspond to high concentration of radioactivity. Note the marked uptake in a certain area of the developing enamel.

4 and 5). The procaine-^{14}C was not retained in the enamel for any longer period, but seemed to disappear within a few hours.

The labelled drugs were not taken up in other mineralizing tissues.

Fig. 4. Autoradiograph showing the distribution of procaine-^{14}C in the molar teeth of a 10-day-old rat at 10 min. after i.v. injection. Note the uptake in the enamel in the cusps of the first molar and in the ameloblasts covering the area. The non-mature enamel of the second molar does not show this marked accumulation.

Fig. 4. MI = first molars; M2 = second molar; D = dental epithelium; NME = enamel at the stage of matrix formation; X = enamel shortly after completion of matrix formation; P = dental pulp.

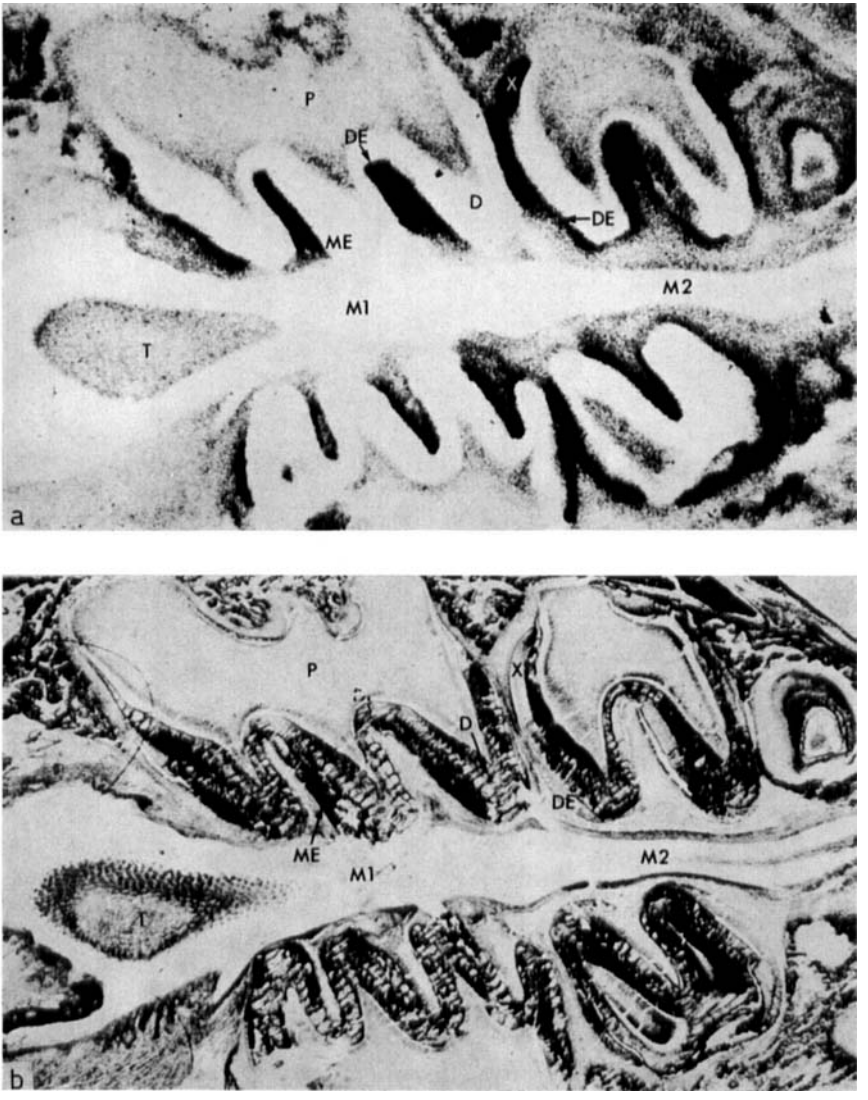

Fig. 5 a. Autoradiograph showing the distribution of procaine-^{14}C of a 15-day-old rat 5 min. after an i.v. injection. Note the uptake in the cervical enamel of the second molar and in the ameloblasts covering the maturing enamel.
b. Microphotograph of the corresponding section stained with hematoxylin and eosin.

Fig. 5 MI = first molars; M2 = second molars; D = dentin, DE = dental epithelium; ME = maturing enamel; X = enamel shortly after completion of matrix formation; P = dental pulp; T = tongue.

DISCUSSION

At present there seems to be no explanation to the accumulation of these drugs in the developing enamel. The penetration of diphenylhydantoin through the whole thickness of the non-mature enamel is similar to that of tetracycline (*Hammarström*, 1967, 1968). However, it was 24 hours before tetracycline penetrated the enamel while diphenylhydantoin-^{14}C had reached the dentino-enamel junction within one hour after administration. With regard to other skeletal tissues they are different. Tetracycline is accumulated in all the mineralizing tissues whereas diphenylhydantoin was taken up only in the developing enamel.

The labelled local anaesthetics listed above and also ^{14}C-labelled nicotine showed several similarities with procaine-^{14}C in their whole body distribution (*Ullberg* & *Hammarström*, 1967). This may indicate that they have the same distribution also in the enamel.

It seems reasonable to assume that the accumulation of these biologically active substances may exert some influence on the development of the enamel. In addition the different distribution patterns of the two substances studied in the present investigation may suggest an interference with different phases of the amelogenesis. This may be of great theoretical interest since the development of dental defects is poorly understood.

The possible effects of these drugs on the development of the enamel of experimental animals are presently under investigation.

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SUMMARY

Procaine-^{14}C, lidocaine-^{14}C, prilocaine-^{14}C, nicotine-^{14}C and 5,5-diphenylhydantoin-^{14}C have been found to be accumulated in the developing enamel of the continuously growing incisor of adult mice. In the present investigation the distribution of procaine-^{14}C and 5,5-diphenylhydantoin-^{14}C have been studied more in detail in the developing molar enamel of young rats.

5,5-diphenylhydantoin-^{14}C was accumulated in the whole protein-rich, non-mature enamel and was retained there longer than in most other tissues of the body.

Procaine-^{14} was not accumulated in the developing enamel until shortly after matrix completion. Then it was taken up through the whole enamel thickness in a certain area. In addition there was a pronounced uptake in

the short, post-secretory ameloblasts. Procaine-^{14}C was not retained in the dental tissues for any longer period.

The possible effects of these drugs on the development of the enamel are presently under investigation.

RÉSUMÉ

ABSORPTION SPÉCIFIQUE DE CERTAINS MÉDICAMENTS DANS LES AMÉLOBLASTES ET DANS L'ÉMAIL EN VOIE DE DÉVELOPPEMENT

Il a été constaté que la procaïne-^{14}C, la lignocaïne-^{14}C, la prilocaïne-^{14}C, la nicotine-^{14}C et la 5,5-diphénylhydantoïne-^{14}C s'accumulaient dans l'émail en voie de développement de l'incisive à croissance continue chez la souris adulte. Dans la présente étude, la répartition de la procaïne-^{14}C et de la 5,5-diphénylhydantoïne-^{14}C ont été étudiées de façon plus détaillée dans l'émail en formation de molaires de jeunes rats.

La 5,5-diphénylhydantoïne-^{14}C était accumulée dans la totalité de l'émail non mature et riche en protéine, et y restait plus longtemps que dans la plupart des autres tissus de l'organisme.

La procaïne-^{14}C ne s'accumulait pas dans l'émail en formation tant que la matrice n'était pas terminée. Peu après ce stade, elle était absorbée dans toute l'épaisseur de l'émail dans certaines zones. De plus, il se faisait une absorption marquée dans les courts améloblastes post-sécrétoires. La procaïne-^{14}C ne persistait guère longtemps dans les tissus dentaires.

Des recherches sont actuellement en cours sur l'action éventuelle de ces médicaments sur le développement de l'émail.

ZUSAMMENFASSUNG

SPEZIFISCHE AUFNAHME EINIGER SUBSTANZEN IN AMELOBLASTEN UND UNREIFEN ZAHNSCHMELZ

Prokain-^{14}C, Lidokain-^{14}C, Prilokain-^{14}C, Nikotin-^{14}C und 5,5-Diphenylhydantoin-^{14}C sind im Zahnschmelz des immer wachsenden Schneidezahn der erwachsenden Mäuse angesammelt. In dieser Untersuchung wurde die Verteilung von Prokain-^{14}C und 5,5-Diphenylhydantoin-^{14}C in grösserer Einzelheit in im Wachstum stehenden Backenzähnen der Ratten studiert.

5,5-Diphenylhydantoin-^{14}C wurde im ganzen Eiweiss-reichen, unreifenden Zahnschmelz angesammelt und blieb da längere Zeit als in den meisten anderen Geweben des Organismus.

Prokain-^{14}C wurde nicht im Zahnschmelz unter Entwicklung angesammelt bevor das Matrix des Zahnschmelzes fertiggebildet war. Dann war Prokain-^{14}C

in der ganzen Dicke des Zahnschmelzes angesammelt. Ausserdem fand sich eine hohe Aufnahme in den kurzen, post-sekretorischen Ameloblasten statt. Prokain-^{14}C blieb nicht lang in den Zahngeweben.

Die möglichen Effekten dieser Substanzen an der Entwicklung des Zahnschmelzes werden vorläufig studiert.

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DISPROPORTIONATE DENTAL ANXIETY
CLINICAL AND NOSOLOGICAL CONSIDERATIONS

by

CARL MOLIN
KENNETH SEEMAN

INTRODUCTION

It is common knowledge that there are few people, who do not experience at least some apprehension in connection with dental care. The vast majority of individuals in our society, however, are sufficiently able to master such feelings to permit sufficient dental treatment to insure at least a modicum of dental health. There does exist a group of individuals, however, who are so intimidated by even the thought of contact with a dentist that they are unable to make or keep initial dental appointments or allow simple examination of dental status, much less effective management. While these individuals may function adequately in other areas of their lives, this neglect, and often direct concealment of their oral status, constitutes such a handicap that they are in effect cripples with respect to dental health *(Kobrin*, 1960).

Due to a lack of agreement as to the nature of the syndrome or condition from which these individuals suffer, this paper is offered by way of adding to insights into what factors are involved in and contribute to the patients' inordinate fear of dentists. In this connection, the question of nosology will be considered, including such aspects as whether a discrete syndrome or condition is involved at all, and what such a condition might appropriately be called.

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SURVEY OF LITERATURE

Nomenclature. Opinion regarding nomenclature may be seen as taking two primary directions. In one of these directions, the patients are regarded as evincing a phobia — specifically, »odontophobia» (*Borland*, 1962). The current authors hold that such a term should imply a sufficient degree of uniformity and fixed quality in the reaction, along with specificity as to object, and differentiation from other emotional or psychiatric conditions as to warrant consideration as a particular phobic disease entity.

In the other direction, the patients have been considered to be suffering from a fear or anxiety of the dental situation, not so specific or uniform from patient to patient and not so differentiated as to warrant the designation, »odontophobia», but rather falling under a more diffuse category referred to as »dental fear» or »dental anxiety». Considering such fear as more of a natural than a »neurotic» phenomenon, *Coriot* (1946) wrote that »It should be explained to the patient that the fear has nothing to do with pain or extraction but is purely emotional, an anxiety signal unrelated to pain and extraction. Thus by bringing into consciousness a danger of which the ego is unaware, the distinction between objective and neurotic anxiety tends to become obliterated». *Forsberg* (1966), in his study of 420 individuals with marked fear of dental care, similarly chose to emphasize the non-phobic (or more appropriate) aspects of the conditions. It is thus that his paper is itself entitled »Tandvårdsskräck» (»Fear of Dental Care»).

Susceptible population. How prevalent and severe fear of dentists is in the general population is, by its very nature, difficult to accurately determine. One attempt in this direction, however, was made by the Swedish Institute for Opinion Investigations (SIFO, 1962), as commissioned by *Tandvärnet* (a Swedish organization for the advancement of dental health). 1375 individuals between the ages of 12 and 75, representing a normally distributed Swedish population, were questioned as to how they experienced visits to the dentist. Only those who wore fullmouth prostheses were excluded from analysis of the material. Considering the experience of »discomfort» and »pain» as two separate items on the questionnaire, 48 % of those interviewed regarded visits to the dentist to be at least »somewhat» uncomfortable, and 46 %, at least somewhat painful. 14 % reported dental visits to be so uncomfortable, and 10 % so painful that they were unable to follow through with treatment. Women reported severe discomfort more than men (19, compared with 10 %, respectively) as well as severe pain (13 and 8 %, respectively). Despite this, it was discovered that the women, among the total sample interviewed, visit dentists both more frequently and more

regularly than men. Regarding relationship between fear and failure to visit dentists, 20 % had not visited a dentist for at least two years, of which 9 % indicated their fear of discomfort or pain as the primary reason for their negligence. In other respects, the poll indicated that fear of dentists is similarly distributed in sparsely and densely populated areas, that it has a tendency to decrease with increasing age, and that it occurs with the same frequency among those who do and do not actually visit dentists.

The findings that men estimate dental treatment as less uncomfortable an experience than do women, and that fear of dental treatment tends to decrease with increasing age, were corroborated by *Sjögren* (1967), investigating a subject material of 229 patients.

Psychological aspects: Clinical approach and research method. Since there is little doubt, both in the common experience of dental practitioners, and as supported by the above figures, that fear of dentists can indeed be such an emotionally and odontologically debilitating condition, it is remarkable how little has been done to investigate systematically the contributing personal and emotional factors to this fear. Indeed, as *Manheim* has commented (as paraphrased by *Epstein*, 1964), ». . . . it is unfortunate that the further a student progresses into the clinical years of dental education, the more he is aware of the fact that he is being educated to take care of teeth and not to take care of patients».

In our survey of the relevant literature, we have been impressed by the very scarce mention we have found regarding psychological aspects of dental treatment up to World War II. Until that time, dental research was primarily devoted to the finding of solutions to technical problems. Two notable exceptions in this regard were the concern expressed regarding the psychological problems of dental patients by *Gillespie* (1939) and the broad-minded and early approach evident in *Thomas'* work (1929). Thomas wrote that »Modern dentistry requires an adequate study of man and the diseases that afflict him; it takes into account all his faculties and functions, mental and nervous, as well as physical». In illustration of this tenet, Thomas reports a case of a woman who was cured not so much by the dental treatment itself, but by her faith in her dentist.

In the 1940's, the expanding interest in psychosomatic medicine was also reflected in dentistry, and books and papers appeared in rapid sequence. Nevertheless, concerning patients with dental anxiety symptoms, most writers were content to offer broad recipes for management without investigating or discussing the psychological background of the patients they were dealing with.

Psychological aspects: Clinical approach and research method. The

first controlled study of patients with fears of dental care we have been able to find was that performed by Borland and *Shoben* (1954). Using a semistructured interview technique to investigate one fearful and one control group of dental patients (9 women and 6 men in each group), a series of 11 hypotheses concerning the association of various personal features with fear of dental care was tested. These hypotheses involved the following factors: pain tolerance, traumatic oral experience, parental attitude and family background, and personality features. Only correlations with the factor of parental attitude and family background were found to be significant, and it was concluded that fears of dental treatment originated in the developing individual through the influence of parents and other significant persons. Such fears were not considered to be due to the specifics of the dental situation itself.

In another direction, *Crowley et al.* (1956) concluded that personality characteristics — in particular, components of orality — were related to a person's »cooperativeness» in dental treatment. Although they felt that orality could be evaluated by use of pcyshological tests, their own results suggested a weak correlation between this factor and cooperativeness such as could hardly lend itself to use as a predictive instrument in the assessment of individual cases. The factor of castration anxiety in the experience of dental extraction was discussed by *Lewis* (1957), who based his discussions on patients undergoing dental treatment while in psychoanalysis, and on a group of subjects studied under hypnosis.

Borland (1962) felt that the threat of mutilation was directed at nothing less than the bodily location of the self. He writes that he himself experienced several surgical procedures in various parts of his body with no more than moderate anxiety. Nevertheless, when faced with a rather insignificant surgical treatment in his face, he writes that he ». . . . suddenly realized that I was frightened to the point of panic. As I thought about this, I realized that my feelings could be summed up rather by the protest: 'It is much too close to *me*.'»

Stressing still another facet, *Forsberg* (1966) concluded that although such an obvious factor as fear of physical pain does contribute to the patients' fears, the overriding precipitant of such fear was the dentist's berating of the patient for his neglected oral care, hygiene, and for his fear in and of itself.

Among the not too many attempts to develop a systematic and reproducible methodology, a prominent one is that described by *Sjögren* (1967). He discusses the composition of such a questionnaire as can differentiate the following general categories of patients: »Patients who did not experience any fear or discomfort; patients who claimed that certain phases of the treat-

ment sessions might be discomfortable or painful, and therefore reported fear; and patients who had a generalized anxiety conditioned to many, or to all phases of the dental treatment.»

Psychophysiologic methods. The use of psychophysiologic measurement has been described by several authors. *A. G. Ship* (1957) demonstrated a significantly greater drop in circulation eosinophils as a result of oral surgery than lesser dental manipulations, although a direct linear relationship between degree of »dental stress» and eosinophil response was not observed. Following these observations a step further, *Ship* and *White* (1960) found anxiety, fear and apprehension during the course of the dental appointment to be the primary factors in the eosinophil response. Furthermore, barbiturate premedication was observed to exert a 26 % greater effect on stress reaction, as reflected in the same measure, in oral surgery as compated with other dental treatment groups. In a study of blood pressure responses to dental treatment in 17 patients, *I. Ship* (1960) found 6 patients to be nonreactors; 8, reactors; and 3, hyperreactors. The latter evinced often rapid and severe fluctuations in both systolic and diastolic pressures in association with dental treatment. Polygraphic recordings of heart rate, face and hand temperature and GSR were employed by *Lewis* and *Law* (1958) in a study of the effect of the presence of parents on children in the dental treatment room. Increased heart rate was the only significant change found. In another psychophysiologic study on children, *Stricker* and *Howitt* (1965) found that heart rate was significantly higher in anxious than in nonanxious patients.

MATERIAL AND METHOD

Selection of subjects. The subjects for the present study were selected from individuals who had written to a confidential letter and answer program on the Swedish radio, reporting such fear of the dental situation as to prevent them from seeking or accepting often essential treatment. A population of such individuals was assembled by reading several of these letters on the radio, and requesting other listeners with similar difficulties to write to the station. This method of subject recruitment had been previously used by *Forsberg* (1966). It was specifically announced that an investigation was being organized at Karolinska sjukhuset into fear of dental treatment, and that in participating in such a study, individuals would both help to shed light on this condition generally, and be given consideration for their individual difficulties.

A total of 19 subjects were investigated, all of whom satisfied the major criterion of the study they experience a fear of dentists or dental treatment so intense that they had neglected needed care.

Table I.

Positive and negative statements about dentists, and mean scores (maximum score = 5; minimum score = 1)

Positive:	Group Mean Score	Standard Error
1. There is seldom any reason to doubt a dentist's professional competence.	3.7	0.32
2. Dentists are very nice people	3.2	0.25
3. Dentists take their patients' finances into consideration to the greatest possible extent.	2.5	0.18
4. To be a dentist, you have to like people	3.9	0.26
5. Dentists consider very carefully before they recommend any treatment	3.2	0.19
6. You can have complete faith in your dentist	3.6	0.22
Negative:		
1. Dentists readily do work that isn't necessary	1.7	0.29
2. One ought always to distrust his dentist	1.4	0.11
3. Dentists jack up their fees as high as they can	2.2	0.27
4. Many dentists are incompetent	1.7	0.28
5. Dentists are scoundrels and frauds	1.2	0.26
6. You have to be at least a little of a sadist to be a dentist	1.6	0.20

Methodology

Three approaches were used, all during one visit by each patients to the authors at Karolinska sjukhuset: a dental examination, a structured interview, and psychologic inventory.

A. Dental examination. A brief (two minute) dental examination was performed by CM with mirror and lamp to provide an objective, if cursory indication of dental status and the extent of neglect of dental care.

B. Interview. One hour was allowed for the structured interview, which included explorations into the following areas: demographic factors; the frequency and circumstances of previous dental treatment; the nature of the fear experienced, and the factors that evoked the fear; the emotional quality attendant previous dental contacts; attitudes of the subject toward other forms of medical treatment; other potential areas of phobia or prominent fear; attitudes toward the body and bodily functions in general; and the occurrence at the time or in the past of other emotional difficulties.

C. Psychologic inventory. Two questionnaires were administered:

1. A series of six negative and six positive value statements about dentists

(Table I), presented in random order, with response alternatives to each ranging on a 5-point scale from »not at all true» to »to a great extent true.»

2. A word association inventory, consisting in a list of 25 words and phrases describing aspects of dental or medical treatment, each followed by a list of eight words describing negative, neutral or positive feelings. The subjects were asked to indicate whether they did or did not associate each feeling word with each dental or medical (treatment) word or phrase. Treatment words and every set of feeling words were randomly presented. The treatment words were chosen so that for every dental word, wherever possible, there would also be presented at least one corresponding general medical word. Examples of »treatment» words were: »dentist», »physician», »local anesthetic, teeth», »local anesthetic, arm», »tooth extraction», »appendectomy», »periodontal operation». The eight »feeling» words were: afraid, anxious, depressed, angry, nauseated, unmoved, well at ease, and relieved.

RESULTS

A. Dental status

The 19 patients examined with mirror and lamp at the time of the interview varied widely between extremes represented by one 23-year old woman without any signs of active caries or periodontal disease and a 63-year old woman who presented a number of root stumps, sitting in an inflammed and fistulous gingiva, so decayed that a conclusive evaluation was impossible under the circumstances. Most of the others revealed considerably poorer dental and periodontal status than would normally be expected on the basis of clinical experience in patients of corresponding age groups, with respect to caries activity, clinical symptoms of periodontal disease and number of missing teeth.

Prostheses were worn by three patients. These included a 42-year old woman, who suffered from hereditary dental aplasia of several teeth; a 63-year old woman, who had worn a complete upper jaw prosthesis for the past four years; and a 40-year old woman, who had used a partial upper jaw prosthesis for four years (a corresponding lower jaw appliance, constructed at the same time, had not been worn except for a very brief period because it did not serve to disguise any visible losses of teeth).

B. Interview

The range of patient material studied will be described in this section, primarily in terms of trends discernible in the subjects' experience of and reaction to the dental situation. Those aspects of the interview dealing

Table II.

Age distribution of the 19 subjects

Age	Subjects
20—29	6
30—39	5
40—49	5
Over 50	3

with psychopathological features not directly related to the dental situation will be discussed in a subsequent report.

1. *Demographic aspects.* In the current account, 19 patients are considered. All but 3 of the subjects were women. Age range is presented in clusters in Table II. Since the study was performed in Stockholm, there was a preponderance of subjects who were living in and had been brought up in the Stockholm area. 13 subjects were married, 1 separated, and 5 unmarried; and 12 had children. Educational level tended to be low, 12 subjects having gone no further than the elementary grade in the Swedish schools. Of the other 7, two had studied at a university, and 2 were eligible to do so. None had and only one was pursuing a university degree.

2. *Previous visits to dentists and physicians.* 11 of the subjects had not seen a dentist for over 5 years, and 6 of these not for 10 or more years. The average time among all 19 since the last dental visit was 6.8 years. There figures are of interest when compared with the time since the last visit to physicians. Except for five subjects, all had seen a physician within 2 years prior to the interview. For these five, the range was 4 to 6.5 years. The average time since the last visit to a physician among all 19 was 1.78 years. Comparing reactions to dental with those to medical care further, three of the subjects regarded themselves to be definitely and three somewhat afraid of physicians. Of the entire group, however, only four considered that they had to any degree neglected needed medical care. This is in contrast to the entire subject population fearing dentists to the extent of having neglected needed care.

It was characteristic of this group of subjects that they would visit a dentist, with considerable apprehension, in the event of acute pain, but that any routine visits and even treatment of obvious dental pathology and occasionally oral deformities were avoided. Two patients reported instances of neglecting treatment even for acute pain.

3. *Previous dental experience as a contributant to fear.* As to the extent

to which direct experience of dental treatment had contributed toward the subjects' fear, three of the 19 reported themselves to have been afraid of dentists even before their first dental experiences. In contrast, 15 reported specific experiences with dentists that they felt had definitely either produced or significantly contributed to their fear of dentists. Eight patients considered themselves definitely, and four with equivocation to have been faultily treated; and seven definitely and one equivocally to have been brutally handled by dentists.

4. *First dental visit.* Regarding the first dental visit in the subjects' lives, 13 reported that they had gone for purposes of routine checks, four for acute problems, and two for a combination of the two purposes. Three patients reported this first contact to be negative, and four actually as positive. This may be contrasted with experience with school dentists. 16 of the subjects had had school dentists available to them at least part of the time they were attending school. Of these 16, 15 used their services regularly. Seven of negative experience, and none as positive.

5. *Contribution to fear by significant »others».* No subject could recall that either his mother or father had expressed negative attitudes while he was being brought up. 15 reported definitely that their mothers, and 14 that their fathers were not negatively inclined toward dental treatment. Four had definite recollections, and five vague impressions of others among their family or friends having been afraid of dentists. Six felt definitely, and three equivocally that they had been frightened by stories they had heard of dental treatment. 13 of the patients reported definitely, and one equivocally that they were ashamed of being afraid, and eight of the patients had been berated by others for being afraid.

With respect to influencing their own children, 15 subjects had a total of 26 children. 4 of these children were considered to be or have been markedly afraid of dentists. 2 of these 4 were boys, and 2, girls.

6. *Components of the fear.* As to specific aspects of dental treatment that were frightening, it will be seen from Fig. 1 that drilling, extraction, injections, and root filling produced the most frequent response. When asked whether there were any other aspects of the dental situation than the ten they were specifically questioned about, four reported marked fear of dentists as persons. These four considered a major component of their fear to consist in their feeling that the dentist did not care about them, was hard handed, berated them for not caring properly for their teeth or for not cooperating adequately during treatment, or did not inform them about or psychologically prepare them for the treatment undertaken. This element may be seen in the same context as that of a feeling of helplessness, which three patients

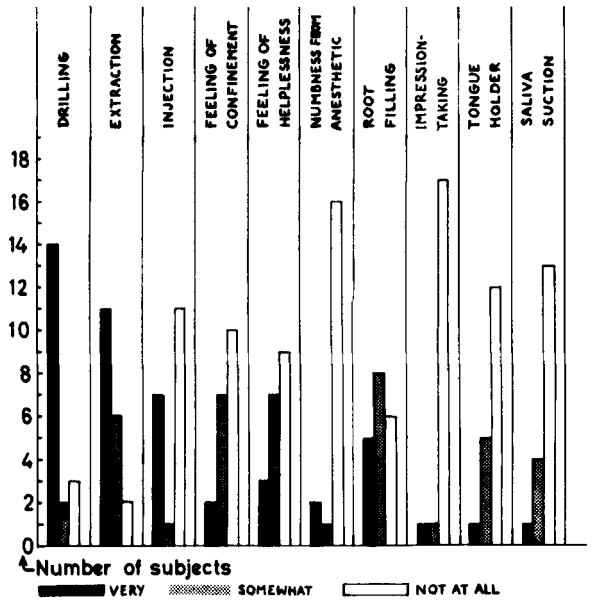

Fig. 1. Number of subjects who were very, somewhat, or not at all afraid of 10 specified elements in dental treatment.

reported to be very much, and seven at least to some extent a part of their fear. Other factors, not indicated in Fig. 1, of which subjects were specifically afraid included probing (two patients), the dentist's lamp (one patient) and the smell in the treatment room (one patient).

7. *Pain and fear.* Regarding the relationship between experience of pain and fear of dental treatment, 12 subjects reported themselves to be afraid of experiencing pain during treatment, and six of these 12 regarded this dimension of fear to be extreme in their cases. When asked whether they regarded themselves to be very sensitive to pain in general, only two replied definitively and five with equivocation that they were. This aspect of fear of pain as specific to the dental situation was further demonstrated by only three of the 19 patients reporting themselves to be afraid of the pain experienced in connection with any other form of medical treatment.

C. Psychologic inventory

1. *Statements about dentists.* It will be seen from Table I that there was a tendency to assign relatively low scores to the negatively weighted, and

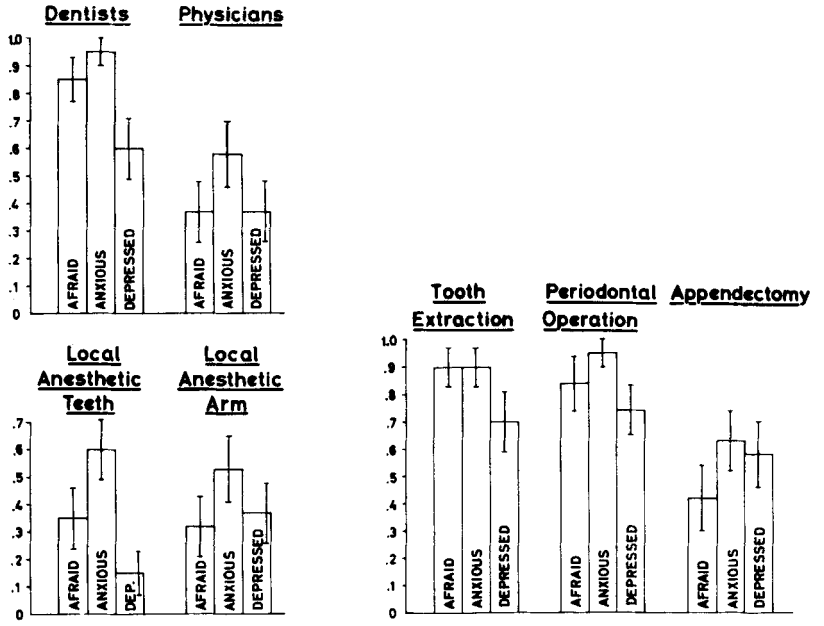

Fig. 2. Mean scores of association of feelings of fear, anxiety and depression to 9 treatment phrases describing aspects of dental or medical treatment (maximum score = 1.0; minimum score = 0).

high scores to the positively weighted statements. The highest scores (thus expressing strongest agreement) were received for statements to the effect that dentists are professionally competent persons, that one can have confidence in. Particularly low scores were received for such strongly negative statements as those to the effect that dentists are incompetent scoundrels and sadists that one ought to distrust.

2. *Word-association.* In the questionnaire in which the subjects were asked whether they did or did not associate eight »feeling» words to each of a series of 25 dental or medical »treatment» words, the three feeling words at the negative end of the spectrum — afraid, anxious, and depressed — produced the most pronounced variations in average response from one administration to another, and from dental or medical word to word. Fig. 2 presents the most striking trends in this inventory. It will be seen that negative response to dental words tend to be high, while corresponding medical words, lower. Thus, for example, an appendectomy tended to be perceived as less negative than either a dental extraction or periodontal operation; and physicians as less negative than dentists.

DISCUSSION

Nomenclature. On the basis of both the published literature, previous clinical experience, and the results presented above, the authors have been impressed with both the specificity of the syndrome — the patients often seem intractible in their fears, which tend to be specific to the dental situation — and the diffuseness — the fears can be prompted by various aspects of the dental situation, in individuals of varying emotional status and background and to differing degrees of intensity. Furthermore, although we feel that the fear or anxiety experienced may be regarded as out of proportion to the stimulus, and thus in the nature of a phobia, it does occur in response to a threatening and painful situation. Thus there were decidedly phobic qualities among the patients studied, as evidenced by the remarkable degree of avoidance of any contact with dentists that characterized many of them, even under circumstances of acute pathology, and involving such mild measures as examination alone. The absense of phobic quality, however, was apparent in that what the patients tended to fear were specific elements in dental treatment (most prominently, drilling) because they were physically painful.

It is thus the consideration of the authors that, in view of the absence of a sufficiently consistent conglomerate of symptoms, that the malady involved does not justify classification as a specific *syndrome,* but rather as a more general and diffusely definable *condition.* Since this condition is seen as lying on the spectrum part-way between »appropriate» anxiety and phobia, the designation of »disproportionate dental anxiety» is suggested.

Other characteristics of »Disproportionate Dental Anxiety». The authors were impressed by the extent to which the patients were strongly conditioned by negative experiences with dentists during treatment. Thus, although the patients were able to tolerate similar intensities of pain in other circumstances, they were taught by specific dentists, who were perceived as brutal, punishing, uncaring or distant, that such pain represented a form of threat in the dental situation. In particular, school dentists were generally portrayed as rushed, at best, and purposively inhumane at worst. This attitude is mentioned in recognition of the fact that there have been changes in both approach and technique used by dentists in the schools since the days when many of the subjects were students.

The interpersonal aspect was further emphasized by the large proportion who were ashamed of their fear, many of whom were so reluctant to demonstrate this fear to *dentists* that they avoided needed treatment. The extent of neglect of treatment, revealed through its consequences, was apparent in the cursory dental examination, performed at the time of the interview.

The fear did not seem to be propagated to any appreciable extent by any other interpersonal influences than those involving the dentist. Thus, parents of the patients tended to have positive attitudes toward dental treatment, and only a small proportion of the patients' children (4 out of 26) were reported as having afraid. (Of the four, one was no longer afraid, and the other three were sufficiently able to control their fear to permit treatment.) This finding may be contrasted to the conclusion of Borland and Shoben, cited above, that fears of dental treatment originated in the developing individual through the influence of parents and other significant persons. Even though there were accounts of other friends or family members having been afraid of dental care, and of having heard frightening tales of dental treatment, this was presented with considerably less emotional emphasis and regarded as much less significant by the patients than the effects of specific dental treatments at the hands of specific dentists.

An aspect that may be encouraging with respect to bringing such a population to eventual treatment was that the aversion to dentists did tend to be specific to particular dentists. The results, in particular of the inventory involving statements about dentists, indicated that the patients still had relatively positive feelings about the dental profession as a whole. Moreover, the hope of finding a more considerate dentist had constituted a prominent motivation for many to report to the investigation in the first place.

This last aspect raises a major point concerning the representativity of the subject population for the general population of individuals exhibiting some form of »disproportionate dental anxiety». They were recruited in a highly specific manner, from a limited geographic area, reported with high degrees of motivation, and were strongly skewed in sex distribution (16 of the 19 discussed, were women, as were a preponderance of Forsberg's subjects, drawn from the same source). Although we have no way, within the scope of this study, of knowing how representative they were for all persons with this difficulty, our subjects can be considered as representative of at least one segment of this larger population, and a segment that can be effectively treated. Certainly a problem to be considered in future investigations would be how one might motivate others so as to attain a broader and perhaps more diverse sampling of individuals with »disproportionate dental anxiety».

ADDENDUM

Since this paper was written all of the patients, except one (the 63-year old woman) have been able to accept necessary dental treatment. The therapy program has consisted of two interpersonal therapy programs — one

affectively orientated involving counseling and one cognitively orientated involving instruction — given in connection with ordinary, but of course very carefully instituted, dental treatment.

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SUMMARY

The condition of »disproportionate dental anxiety» has been defined and discussed, based on review of literature and an investigation of patients with inordinate fear of dental treatment. The investigation included a cursory dental examination, a structured interview, and psychological testing.

»Disproportionate dental anxiety» is considered as a condition involving such apprehension at even the thought of contact with dentists, that necessary — often acutely needed — treatment is avoided. Since the anxieties experienced by the patients are in response to a real uncomfortable and frequently painful stimulus, but tend to be out of proportion to the threat experienced in the same situation by the population at large, the condition is regarded as lying on a continuum part-way between the extremes of »phobia» and »appropriate anxiety.» Moreover, since there is minimal uniformity in the reactions of the patients, a defining designation of »syndrome» is avoided.

The major tendency found among the patients currently investigated was the development of their fears in connection with specific forms of treatment at the hands of specific dentists. The prevailing feeling was that if a considerate dentist could be found, the condition described could be mitigated.

RÉSUMÉ

ANXIÉTÉ DENTAIRE DISPROPORTIONNÉE
CONSIDÉRATIONS CLINIQUES ET NOSOLOGIQUES

Se basant sur une revue de la littérature et sur une étude de patients souffrant d'une peur démesurée des traitements dentaires, les auteurs ont défini et discuté »l'anxiété dentaire disproportionnée». L'étude des patients comprenait un examen dentaire superficiel, un interview suivant un plan déterminé, et des tests psychologiques.

»L'anxiété dentaire disproportionnée» est considérée comme une affection comportant une appréhension telle, même à la pensée du contact avec les dentistes, que les patients évitent le traitement nécessaire, dont le besoin est cependant souvent aigu. Etant donné que les angoisses éprouvées par les patients sont une réponse à un stimulus réellement désagréable et souvent douloureux, mais ont tendance à être hors de proportion avec la menace ressentie dans la même situation par la population en général, cet état est considéré comme une transition continue entre les extrêmes constitués par la »phobie» et la »peur justifiée». De plus, étant donné qu'il n'existe qu'un minimum d'uniformité entre les réactions des patients, la désignation précise de »syndrome» est évitée.

La tendance dominante parmi les patients ordinairement examinés était le fait que leurs craintes se développaient à l'occasion de certaines formes déterminées de traitements, exécutés par certains dentistes déterminés. On avait en général l'impression que, s'il était possible de trouver un dentiste compréhensif, les troubles décrits ici pouvaient être atténués.

ZUSAMMENFASSUNG

UNVERHÄLTNISMÄSSIG GROSSE FURCHT VOR ZAHNBEHANDLUNGEN

KLINISCHNOSOLOGISCHE BETRACHTUNGEN

Der Zustand des »Zahnarztschrecks» ist definiert und anhand der Literatur sowie einer Untersuchung von Patienten mit übertriebener Angst vor Zahnbehandlungen diskutiert worden. Die Untersuchung bezog eine summarische Zahnuntersuchung, eine gegliederte Befragung und psychologische Teste ein.

Die übergrosse Angst vor der Zahnbehandlung ist als Zustand anzusehen, der schon beim blossen Gedanken an den Besuch beim Zahnarzt solche Furcht auslöst, dass eine — oft akut — notwendige Zahnbehandlung unterlassen wird. Da die von den Patienten empfundene Furcht einem wirklich unangenehmen und oft quälenden Stimulus entspricht, jedoch dahin tendiert, über die Proportionen dessen hinauszugehen, was von der Allgemeinheit in der gleichen Lage gewöhnlich als bedrohlich empfunden wird, ist man der Ansicht, dass der Zustand auf der Grenze zwischen den Extremen »Probie» und »angemessene Angst» liegt. Weil zudem eine minimale Einförmigkeit in den Reaktionen der Patienten herrscht, wurde er nicht als Syndrom definiert.

Die bei den untersuchten Patienten gefundene Haupttendenz war, dass der Angstzustand in Zusammenhang mit einer bestimmten Behandlungsform bei gewissen Zahnärzten ausgelöst wurde. Es herrschte das Gefühl vor, dass ein rücksichtsvoller Zahnarzt den beschriebenen Zustand lindern könnte.

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