

Teeth, vomiting and diet: a study of the dental characteristics of seventeen anorexia nervosa patients

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Summary

Seventeen anorexia nervosa patients were examined dentally and their dietary histories and eating habits studied. Analysis of the data confirmed earlier observations of characteristic dental deterioration associated with anorexia nervosa. The deterioration included a pattern of enamel dissolution in cases of vomiting, regurgitation, and/or the consumption of large amounts of citrus fruits; and an altered caries response due to abnormal carbohydrate consumption. Despite the patient's probably insistent denial of 'anorectic' eating habits, the general practitioner should consider the existence of anorexia nervosa in the presence of such abnormal features, especially in young women. The relationship of these findings to larger populations with similar eating habits is discussed.

Introduction

Many medical conditions are accompanied by oral manifestations. The purpose of this study was to explore the possible links between anorexia nervosa, the teeth and related oral tissues.

The illness, which predominantly affects young women, is characterized by a tendency to manipulate diet to lose weight (Crisp, 1967). Amenorrhoea usually supervenes at an early stage. Two distinct groups are found clinically. Firstly, and more commonly, there are those who lose weight by avoiding carbohydrate which, in extreme cases, may lead to a concomitant reduction in protein and fat intake. The second smaller group induce vomiting to lose weight or maintain a low weight. This group tend also to have periods of overeating, at which times their diet may contain large quantities of carbohydrate. After eating, both groups suffer intense guilt feelings and the latter group in particular may take large quantities of laxatives and fruit to overcome constipation and to rid themselves of the food which they have consumed, but not vomited, and also to achieve temporary weight-loss through

dehydration. Profound electrolyte disturbances, especially hypokalaemia, arise in this latter population.

Investigators generally regard the illness as having important psychological determinants, although they differ in their views of the mechanisms involved. Crisp (1970) believes that the anorectic has regressed both psychologically and physiologically to a prepubertal level thereby avoiding overwhelming adolescent turmoil. He and his fellow workers have shown that at low body-weight the anorectic has low serum levels of the reproductive hormones which revert, on re-feeding, to normal values (Palmer *et al.*, 1975).

Some authors have tended to see anorexia nervosa as an extreme aspect of an almost universal female adolescent pattern of dieting, commonly rooted in a desire to reduce fatness. Nylander (1971) in his Swedish study showed that dieting behaviour appeared to be endemic and epidemic in girls' schools. Most of the girls reported feeling fat, although by objective criteria they were not overweight. Some 76% of 18-year-old girls in this latter group were striving to lose weight. If mild cases are included, Nylander stated that 10% of girls in his study reported experiencing an anorexia nervosa syndrome. Certainly it would appear that 1% had the disorder. This accords with findings recently reported in the U.K. (Crisp, Palmer & Kalucy, 1976).

Accompanying the growing interest in anorexia nervosa from a medical and psychiatric standpoint, certain related dental manifestations of the disease have become apparent (Hellstrom, 1974). In one series of 300 patients gathered and studied by one of the authors (A.H.C.) over the past 15 years, dental deterioration was noted as particularly prevalent among a group of anorectics, often pre-morbidly obese, who at presentation revealed the syndrome of bulimia/vomiting/purging as the main means of maintaining a low body-weight.

Meanwhile, over a 5-year period, one of the other authors (P.H.) noticed that certain specific dental features were exhibited by anorectic patients presenting for restorative treatment at Edinburgh Dental Hospital. Three main characteristics were observed: dental erosion (a mainly superficial loss of dental hard tissue by a chemical process which does not involve bacteria), caries incidence, and periodontal status.

Erosion

Dental erosion was frequently seen, although the mode of presentation differed, and three types of erosion could be distinguished: (a) severe erosion affecting particularly the palatal aspects of the upper incisor, canine and premolar teeth; (b) erosion mainly confined to the labial surfaces of the incisor teeth; (c) a generalized but very minimal loss of enamel by erosion seen on the occlusal surfaces of molars and premolars, reflected clinically by unnaturally highly polished amalgam restorations sometimes flush with but occasionally slightly proud of the enamel surface.

Caries incidence

Caries incidence was atypical in comparison with that of the normal population. Three presentations could be distinguished: (a) an unusually low caries rate; (b) a pre-disposition to cervical caries; (c) a rapidly destructive 'leathery' lesion of dentine, leaving large areas of enamel undermined.

Periodontal status

The general periodontal condition of the patients, with regard to the degree of inflammation present, was good. In those patients who vomited regularly a very low level of dental plaque accumulation was found.

Materials and methods

To determine whether these initial observations had any broader significance, a random group of seventeen anorectic patients, fourteen female and three male, ranging from 13 to 33 years, were interviewed and dentally examined. The time elapsing from first diagnosis ranged from between 2 months and 13 years. Four patients were out-patients and the remainder were receiving in-patient treatment at the Psychiatric Department of St George's Hospital. The interview involved questions as to the duration of the illness, dietary habits, and vomiting or regurgitation pattern, if any.

The time elapsing since the initial diagnosis was considered to be an unreliable guide as to how long the disease had existed. In most instances anorexia nervosa begins early and only a vague history of 'eating difficulties' from adolescence is available.

Medical advice is often sought by parents or relatives only when an advanced stage of emaciation is reached, and at the time the definitive diagnosis is made the disease may have already been present for several years.

Enquiries were made as to the existence of any dental problems, the frequency of oral hygiene measures (tooth brushing) and whether past professional dental care had been regular. The patients' weight and the number of weeks they had been eating a normal diet were noted.

Dental examination took account of teeth which had been extracted, other than wisdom teeth or those removed for orthodontic reasons, restorative treatment which had previously been necessary, and the distribution and pattern of active carious and erosive lesions were recorded. The degree of inflammation and existence of pockets, was recorded using the Periodontal Index scoring technique of Russell (1956). A general assessment was also made of the quantity of dental plaque.

Results

The sample was divided into three major groups: those who in the last 3 years had persistently vomited food; those who in the last 3 years had persistently regurgitated food; and those who had not vomited or regurgitated food. As can be seen from Table 1, each group had a similar mean age. There were no noteworthy differences in the dental care of the subjects in each group (Table 2), although on average the non-vomitters had had more time on a normally balanced diet before examination than the vomitters and regurgitators. However, in the context of the time-span of the illness this difference is not expected to impair the validity of the findings.

TABLE 1. General statistics of seventeen anorexia nervosa patients divided according to vomitive history

	Average age and range	Average weeks on normal diet before examination
Vomitters	24.4 (17-33)	11 (2-17)
Regurgitators	21.4 (13-34)	6.4 (0-14)
Non-vomitters	21.9 (16-33)	15.9 (0-41)

The most serious dental accompaniments of anorexia nervosa appear to be those associated with prolonged vomiting or regurgitation (Table 4). Dental erosion and loss of teeth was significantly more common in the vomiting and regurgitating population than in the non-vomitters ($P < 0.04$). Further, there was a tendency for the enamel of vomitters as a group to be more severely eroded than that of regurgitators (Tables 3 and 4), although this did not reach significance levels. In the two most severe cases, there were erosions of the palatal

enamel of the upper incisors, canines and premolars leading to 'shelling out' of the tooth crown. In two subjects in the regurgitators' group, the amalgam restorations were highly burnished, suggesting that at some stage there may have been a mild erosion/attrition effect in operation (Ramfjord and Ash, 1971).

Although most of the subjects ate fruit regularly and in large quantities, and although many preferred citrus to non-citrus fruits, only two subjects showed advanced labial enamel loss due to erosion. Slight evidence was present in a further two cases.

The frequency and severity of caries and restorative work was more prominent in those who

TABLE 2. General and oral care information of a sample of seventeen anorexia nervosa patients

Patient	Age	Sex	Weight when examined as % of target weight*	Weeks on normal diet before examination	Dental care		
					Home (brushing frequency) per day	Professional checks	Awareness of dental state and/or dental problems and patient's remarks
M.B.	24	M	101	17	1	Irregular	Much dental trouble for 5 years. Prolonged treatment; teeth crumbled
J.C.	17	F	98	5	2	6/12	Aware of trouble with teeth. Needs treatment at present
S.M.	26	F	90	10	2	6/12	Teeth are sensitive. Much work done in last 12 months. Dentist has remarked that the teeth seem to be dissolving away from inside; toothache at present
M.G.	22	F	109	21	2	6/12	Sensitive teeth at gum-margin
G.G.	33	F	71	2	2	6/12	Teeth suddenly went bad; many just broke; hard to eat now since no lowers remain
B.W.	25	F	67	0	1	6/12	Teeth have been a constant source of trouble for 10 years. Many extractions
D.P.	20	M	70	0	2	6/12	Nil
S.H.	34	F	95	9	3	6/12	Nil
C.B.	15	F	100	9	2	6/12	Nil
K.L.	13	F	100	14	2	6/12	Nil
G.H.	20	F	67	0	2	6/12	Less trouble now than when younger
K.D.	33	F	94	9	2	6/12	Teeth have improved since age of 16 years, accompanying start of anorexia; were bad as a child
M.L.	16	M	97	41	2	6/12	Keen to keep teeth
M.H.	27	F	99	24	2	6/12	Has heard of anorectics having trouble; does not want extractions
B.N.	21	F	86	0	2	6/12	Very anxious to retain teeth; finds act of eating difficult
A.W.	18	M	100	27	2	Irregular	No fillings for several years
P.S.	18	F	96	6	2	6/12	Nil

* 'Target weight' is the mean matched-population weight for the patient's height and age.

TABLE 3. Dietary history and results of dental examination of a sample of seventeen anorexia nervosa patients

Patient	History of vomiting or regurgitation	Dietary habits	No. of missing teeth	Restorations and/or caries	Erosion	Periodontal condition	Plaque
M.B.	Vomited for 3 years	Citrus fruits, e.g. oranges 4-5/day for 5 years	—	+++ T	PC +++ OL	—	+
J.C.	Vomited for 2 years	Citrus fruits, e.g. 2-3 grapefruit/day	—	+ T	Nil	—	+
S.M.	Vomited for 3 years	4 Lemons/day, lemon juice	—	+++ C	LO CP	—	+
M.Q.	Vomiting intermittently	Bulimia, citrus fruits	—	+ T	+ L	+	++
G.G.	Vomited intermittently 15 years. Bulimia	Low CHO/fruit/fads	21	+++ C	Nil	—	++
B.W.	Vomited 3 years ago. Slight regurgitation. Bulimia	Low CHO/fruit/fads	11	—	+ O	—	+
D.P.	Regurgitation 4 years	Low CHO/fruit/fads	—	+++ C	+ O	—	+
S.H.	Slight regurgitation	'Several' oranges, lemons or grapefruit. Drinking 'pure lemon juice'	3	+ C	+ OL	—	++
C.B.	Slight regurgitation	Low CHO/fads. No citrus fruit	1	+ T	Nil	—	+
K.L.	Slight regurgitation	Low CHO/fruits mainly non-citrus	—	—	Nil	+	+++
G.H.	Regurgitation 3 years ago	Oranges 2/day/5 years	—	—	Nil	—	+
K.D.	Slight vomiting for 6/12, 3 years ago. No regurgitation	Low CHO/fruits (mainly non-citrus)	—	—	Nil	+	++
M.L.	None	Low CHO/fruit/fads	—	—	Nil	+	+
M.H.	None	Low CHO/fruit/fads	—	+ T	Nil	+	+++
B.N.	None	Low CHO/fruit/fads	—	+ T	Nil	++	+
A.W.	None	Low CHO/fruit especially citrus/ fads	—	—	+ O	—	+
P.S.	None	Low CHO/fruit	—	+ T	Nil	+	+

Carious cavities and/or restorations: 0-6 = —; 7-13 = +; 14-20 = ++; 21-∞ = +++.

Erosion: (i) degree of erosion: normal appearances = —; slight loss of surface detail or burnished amalgams = +; loss of full thickness of enamel = ++; loss of enamel and dentine = +++. (ii) site of erosion/carious lesions: P = palatal surfaces; O = occlusal surfaces; C = cervical surfaces; L = labial surfaces; T = 'typical' distribution of carious lesions as would be anticipated in a normal population group.

Periodontal scores: (P.I.) 0-1-0.5 = — negative; 0.5-1.5 = + mild; 1.5-4.0 = ++ moderate; 4.0-8.0 = +++ severe.

Plaque score: low = +; medium = ++; high = +++.

CHO = Carbohydrate.

TABLE 4. The association between dental damage and the severity of vomiting in seventeen anorexia nervosa patients

	No. of subjects	No. of subjects affected	Severity of erosion	No. of teeth missing
Vomiter within past 3 years	5	4	+++	—
			+++	—
			+	—
			Nil	21
Regurgitators within past 3 years	5	3	+	11
			+	—
			+	3
Non-vomiters or regurgitators within past 3 years	7	1	+	—



FIG. 1. Typical features seen in an anorectic patient who both consumed and vomited a high citrus fruit diet. Loss of occlusal form on lower molar; amalgam stands proud of tooth substance.



FIG. 2. Same patient as Fig. 1. Deep erosive 'shelling-out' of occlusal surface (in this case, atypically on a molar).

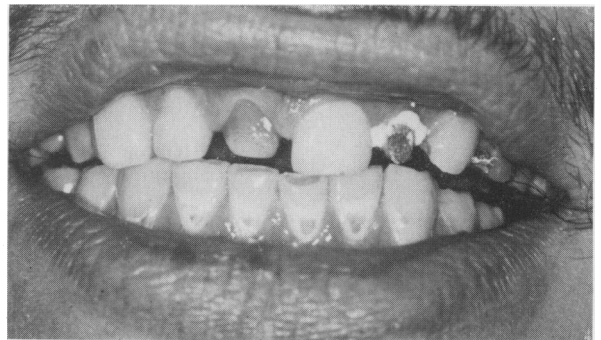


FIG. 3. Same patient as Fig. 1. Cervical decalcification of lower incisors due to citrus fruit diet. Porcelain jacket crowns had been placed on upper incisors following palatal tooth substance loss due to protracted vomiting. Posterior bite collapse has resulted in the fracture of two crowns.

vomited than in those who merely regurgitated their food. Similarly, those subjects who had no history of vomiting had less caries than those who regurgitated or vomited their food regularly (Table 5). In two patients, an unusually large number of teeth had to be extracted despite regular conservative treatment. In four patients, including one where there had been multiple extractions, there were extensive cervical lesions.

TABLE 5. Demonstrating the incidence of dental caries and restorative work in a sample of seventeen anorexia nervosa patients

	No. in sample	Caries and /or restorative work		
		Severe	Average	Low
Vomiters	5	3	2	0
Regurgitators	5	1	2	2*
Non-vomiters or regurgitators	7	0	3	4

* One was only 13 years old.

Of ten patients in this series who either vomited or regurgitated only two had any periodontal inflammation and then only to a mild degree. This was surprising as several patients had excessive plaque. However, of the seven avoiding carbohydrate five had periodontal inflammation and pocketing, one severely so (Table 6). The prevalence of periodontal inflammation was significantly more common in non-vomiters than in vomiting or regurgitating anorexics ($P < 0.04$).

TABLE 6. Demonstrating incidence of periodontal inflammation with vomiting history in seventeen anorectic patients

	No. in sample	No. with periodontal inflammation
Vomiter within past 3 years	5	1*
Regurgitator within past 3 years	5	1*
Non-vomiter or regurgitator within past 3 years	7	5†

* Mild inflammation; † 4 mild inflammation, 1 moderate inflammation.

The total absence of plaque previously associated with vomiting (see below) and attributed to depressed bacterial growth in the acid environment was not found in the sample patients.

Discussion

Dental afflictions in patients with anorexia nervosa may result from three factors: firstly, the effects of frequency and prolonged vomiting; secondly, the unnatural diet; thirdly, the intra-oral effects con-

comitant with wasting and dehydration of the patient during starvation.

Vomiting

The term perimyololysis is used by Holst and Lange (1939) to describe the destruction of tooth tissue due to persistent vomiting. Cases of dental damage resulting from regurgitation or vomiting as symptoms of such medical conditions as hiatus hernia (Howden, 1971), 'gastric dysfunction' (Holst and Lange, 1939), duodenal or peptic ulcer (Allan, 1969), antabuse therapy for alcoholism (Lindon, Roper and Wielin, 1968), and during pregnancy (Stafne and Lovstedt, 1947) are well documented.

As long ago as 1937 Bergen and Austin reported a case in the dental literature of severe perimyololysis affecting a 26-year-old school teacher. The patient was described as a 'walking skeleton' and appeared to have many of the symptoms of anorexia nervosa, but it was not recognized as such. The association between anorexia nervosa, vomiting and perimyololysis in nine cases has recently been reported in the dental literature.

Persistent vomiting is generally assumed to occur in less than 33% of anorectic patients. In these cases, however, it must be considered to be a potential source of dental deterioration. The low pH of vomitus projected over the dorsum of the tongue first reaches the palatal aspects of the upper incisors, canines and premolars and over a prolonged period will cause enamel destruction. Although other teeth may be affected, it is usually only to a limited extent (contact with the lips, cheeks and lateral borders of the tongue and the buffering capacity of saliva appear to protect them).

Of the five persistent vomiters in the series, two did not show perimyololysis. One of these had generalized mottled enamel caused by living in an area where the fluoride content of water was high. It was possible that decalcification did not occur owing to reduced solubility of fluoridated enamel. The other who was 33 years old had had twenty-one teeth extracted, possibly as a result of persistent vomiting.

The highly burnished surfaces of the amalgam fillings seen in some patients were attributed to abnormal occlusal wear on the metal following loss, by erosion, of a very thin layer of the surrounding enamel.

Diet

The usual anorectic diet, typified by periods of low or non-existent carbohydrate intake interspersed, in some cases, with bouts of high carbohydrate consumption, can have dental significance. Carbohydrate, acted upon by acidogenic bacteria in dental plaque, is generally regarded as being responsible for the initiation of dental caries. It

therefore follows that a reduced carbohydrate intake should be associated with a reduced prevalence of caries. Abnormally high carbohydrate intake is most associated with vomiting anorexics. However, overeating, albeit transient, may have a detrimental effect. It was noteworthy that the two patients who had multiple extractions were also prone to bulimic episodes. It was possible that at some stage a rapidly destructive type of caries had prevailed, associated with an excessive carbohydrate intake, but without more precise information it was difficult to attribute this to a hyperphagic phase.

What could be predicted with more certainty, however, was that the predisposition shown by a number of anorectic patients to 'slimming' foods, in particular raw citrus fruits such as oranges, lemons and grapefruits, or their juices would undoubtedly harm their teeth. In some cases fruit was eaten each day over a period of months or years and on occasion, in those attempting to induce diarrhoea, completely replaced the normal diet.

The pH of these substances is 3.5, at which enamel decalcification occurs (McClelland, 1926) and much has been written on the adverse effects produced by acid ingested in this form (Stafne and Lovstedt, 1947; Allan, 1967; Mannerberg, 1963). The clinical pattern is of enamel loss related to the place of first contact of the acid with the tooth and is therefore mostly seen on the labial aspects of the incisors. There is a progressive rounding-off of the tooth margins and eventually the dentine is exposed.

Dehydration and wasting

The starvation and associated weight-reducing manoeuvres seen in anorectic patients leads to wasting and dehydration; in consequence secretions are reduced. This has dental implications, for the saliva will be affected both in quantity and composition. Reduced salivary flow is associated with an increased caries rate with often a predominance of cervical lesions. The administration of certain anti-depressive drugs may also reduce salivary secretion, and anorectic patients receiving this medication may therefore have a two-fold deficiency.

Alteration in salivary composition caused by electrolyte imbalance may lower the buffering and remineralizing capacity of saliva. Lack of salivary buffering renders the teeth more susceptible to acid attack; be it acid arising from dental plaque metabolism, leading to caries, or acid from ingestion or vomiting, leading to erosion (Larsen, 1973). Reduced ability of saliva to remineralize enamel surface imperfections suggests that even at the best of times, when no other adverse factors are operating, emaciated anorectic patients will be particularly prone to suffer from generalized dental deterioration.

The apparently low prevalence of periodontal disease is hard to explain, but it is possible that owing to an unusual immunological make-up, anorectic patients may have a modified and reduced inflammatory response to dental plaque. Certainly there is evidence that they are more resistant to common minor ailments such as colds and influenza than are their better nourished brethren (Crisp, 1970).

Future investigations

This study was concerned with a small number of anorectic patients over a relatively short period. To elucidate more fully the dental changes, it would be helpful to carry out a larger survey over a longer period.

The pattern of erosion should be measured more precisely, possibly using as a guide tooth dimensions from study casts taken at various time intervals. Ideally the caries rate should be followed up from an early age.

Chemical changes involving saliva require quantitative evaluation, and considerably more detailed study is required to judge the significance, if any, of the rather subjective observations regarding the periodontal status.

Treatment

Whereas the somatic changes occurring with anorexia nervosa are reversible, those affecting the hard dental tissues are not.

Early diagnosis, avoiding the unfortunate sequelae accompanying protracted vomiting and harmful dietary changes, is the ideal. However, when this is not possible, certain local measures can be suggested. If vomiting persists, protection of the teeth with alkali (magnesium hydroxide) filled plastic splints as described by Rowe (1972) may be useful. In an attempt to reduce enamel solubility so as to resist erosion, sodium fluoride has been recommended (Holloway, Mellanby and Stewart, 1958). It may be used either by periodic topical application (Xhonga and Sognnaes, 1973) or as a 0.05% mouthwash combined with bicarbonate after each vomiting incident (Hellstrom, 1974). The application of fluoride may also be useful to desensitize troublesome areas of exposed dentine following enamel loss by erosion. Protection of the enamel with plastic fissure sealants has also been advocated to reduce erosion, although the results do not seem to be particularly successful (Xhonga and Sognnaes, 1973). Rinsing of the mouth with plain water after vomiting to remove any acid retained between the papillae on the dorsum of the tongue may also be helpful. The physician should mention to the patient the harmful effects on teeth of vomiting or excessive amounts of fresh citrus fruit.

Where gross tooth destruction has occurred, full

coverage restorations which will both replace lost tooth tissue and provide protection against further damage are indicated. It is important that a high standard of dental care should be maintained, both at home and professionally, and check-ups at 4-month intervals are advised.

Current medical and psychiatric investigation of this intriguing disease is revealing some interesting features which may help to shed further light upon aetiology, and to open up new avenues of treatment. In the meantime, by being aware of the dental problems, the physician may be able to help to improve the patient's unhappy lot.

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