

## THE THERAPEUTIC APPLICATION OF VITAMIN C IN PERIODONTAL DISEASE.

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### INTRODUCTION.

It has long been known that a deprivation of vitamin C will bring on the condition of scurvy. It is also understood that the disease is now comparatively rare following on improved conditions of living with the advance of medical science. The clinical picture of hæmorrhagic purpura with swollen and bleeding gums in the vicinity of the teeth is not a common picture in our hospitals, although these cases still occur, sometimes rather unexpectedly in people whose condition of living on the surface appears to satisfy modern standards (Jennings and Glazebrook, 1938). This latter picture is the end-result of a series of pathological changes, each of which will present its own clinical features, and in the early stages changes in the mucous membranes of the mouth are to be expected. The condition of gingivitis has been described by some as such a subscorbutic state, and Kramer (1937) considers that the cause of inflammatory periodontal disease, such as acute gingivo-stomatitis, and chronic gingivitis, is not due to lack of dental hygiene, but to lack of vitamin C.

Recently a trial was instituted of the prophylactic addition of synthetic vitamin C to the diet of the boys in a training establishment of the Royal Navy, and one of us (F.S.R.), having had much previous experience of gum lesions in adolescents and young adults associated with vitamin C deficiency, took this opportunity to observe the effect of ample intake of "Redoxon" brand ascorbic acid (Messrs. Roche Products, Ltd.) upon gum and mouth lesions in these boys.

The investigations into the dietetic intake and urinary excretion of vitamin C by these boys is the subject of another paper. Briefly, these investigations suggested that the optimum addition of vitamin C to the diet was in the neighbourhood of 50 mgm. per day per boy, bringing the total intake to a figure approaching 75 mgm. per day per boy. The addition was made in the form of pure ascorbic acid powder, 25 mgm. being added to cocoa taken in the morning, and 25 mgm. to milk taken at night time, the milk being pasteurized. Titrations of milk and cocoa after the addition, and twenty-four-hourly estimations of urinary excretion, showed that much of these additions reached the consumer, in spite of the heating of the cocoa. The boys under observation were at first saturated by the

addition of large doses—200 to 300 mgm. per day per boy. On saturation being achieved, the dosage was reduced to a maintenance level of 50 mgm. per day per boy. Observations were taken on two groups of boys: (a) those who had been in the training establishment for some time, and had been dentally treated while in the Service, and (b) new recruits. The results of these observations are set out below.

*(a) Boys Already Dentally Treated.*

In the first instance, Group I, comprising approximately 300 boys, were saturated with vitamin C, as described above; and the condition of the mouth in these boys compared with a control group, Group II, of approximately 300 boys living under exactly the same conditions, on a diet otherwise identical. The age of the boys averaged about 16 years, and in both groups the boys had been in the Training Service for about the same length of time. The two groups were chosen independently of the medical and dental authorities undertaking the tests.

All the boys examined had at this time (November, 1938) spent many months in the Service and had undergone dental treatment to the extent of being made "Dentally Fit". Many had received revisional treatment, so that oral sepsis was eliminated and conservancy work completed. Each boy had received instruction as to the use of the toothbrush, with sound knowledge of oral hygiene, and of the cases of gingivitis observed, only those with an obvious cause, namely, a dirty mouth, were of the typical marginal type. Some cases of "chronic hyperplastic gingivitis", where tags of tissue had formed between the interspaces of the teeth, and where the gums had encroached upon the surface of the teeth, were also noted, but in the majority of cases of this type the cause (calculus, &c.) had been removed and healing had commenced, leaving bosses of firm scar tissue. Those failing to heal even after treatment were especially noted.

These types of gingivitis were, however, few compared with the lesion more often observed, which appeared to be without obvious cause, and differed clinically in being a gingivo-stomatitis rather than a gingivitis. In these cases the gums were congested and spongy, the surfaces having a gelatinous feel. Bleeding did not occur on simple palpation, but if one pierced with a probe the hæmorrhage was more copious than usual. The congestion was uniform, from the gums into the sulci on to the buccal mucous membrane, extending backwards and involving the tonsils and the pharyngeal wall as far as the eye could see, and in some cases the lips were of a deeper red, suggesting an increased vascularity.

In all these cases vitamin C deficiency was found, using the "Test Dose" method of Abbasy and Harris (1937). On a dosage of 200 mg. per boy per day, saturation, as determined by urinary excretion, was not

achieved until twenty-two doses had been given. This would appear to indicate that the average deficiency of vitamin C was in the neighbourhood of 4,000 mg. per boy. It must be remembered, however, that not all the vitamins added to the milk and cocoa reached the consumer, and doubtless a proportion of the ingested dose was destroyed in the body or not absorbed.

The laboratory findings certainly showed, however, a marked deficiency, and suggested that the cases were actually examples of subclinical scurvy, and that the marked congestion noted in this gingivo-stomatitis was a probable result of an interference with a healthy cell life, causing a fragility of the vessels and a defective growth of the tissues. This type of lesion should disappear on saturation with vitamin C; and, as Group I were receiving ample vitamin C as compared with Group II, it was to be expected that in the former group gingivo-stomatitis would be abolished, and possibly cases of gingivitis improved.

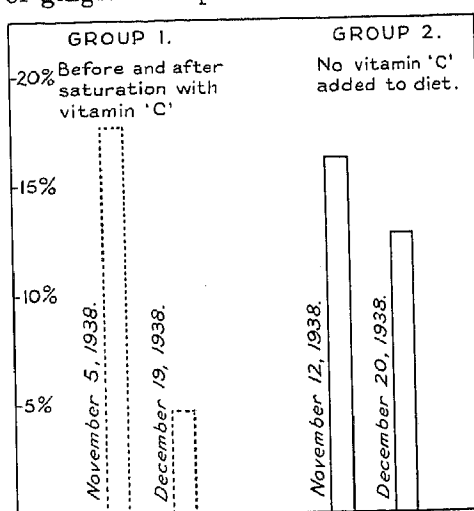


CHART 1.—Incidence of gingivitis and gingivo-stomatitis in boys already dentally treated.

The total number of boys in each of the groups selected was not always available at the time of examination, but the following figures were obtained.

On November 5, 1938, 250 boys of Group I were examined in daylight. 44 cases of gingivitis and gingivo-stomatitis were noted, a percentage of 17.6 per cent. Of these 44 cases, 34 were examples of gingivo-stomatitis, 10 were cases of gingivitis due to a dirty mouth.

Administration of vitamin C was at once commenced as described above, and the Group was re-examined on December 19, 1938, under exactly similar conditions. 247 boys were inspected, and only 12 cases of gingivitis were noted, a percentage of 4.9 per cent., and in all these cases

the gingivitis was of the marginal type associated with a dirty mouth. It is interesting to note that the chronic hyperplastic cases which had persisted in an inflamed condition, after thorough local treatment, had healed, leaving firm bosses of scar tissue. No cases of gingivo-stomatitis were seen.

On November 12, 1938, the control Group were examined in daylight, and 36 cases of gingivitis and gingivo-stomatitis were seen amongst 221 boys, a percentage of 16.3 per cent. Re-examination on December 20, 1938, of 174 boys in this Group showed that 12.64 per cent. had unhealthy gums, the majority being cases of gingivo-stomatitis. Unfortunately the numbers available for examination in the control group had been reduced, but the percentage of gingivitis and gingivo-stomatitis was still significantly high as compared with Group I, where vitamin C had abolished a condition very suggestive of subclinical scurvy.

Chart 1 illustrates these figures.

*(b) New Recruits.*

In January, 1939, 149 new recruits joined the establishment, and a similar investigation was carried out on these boys. 59 of the new recruits were posted to Group I of the previous term, and, to ensure continuity and

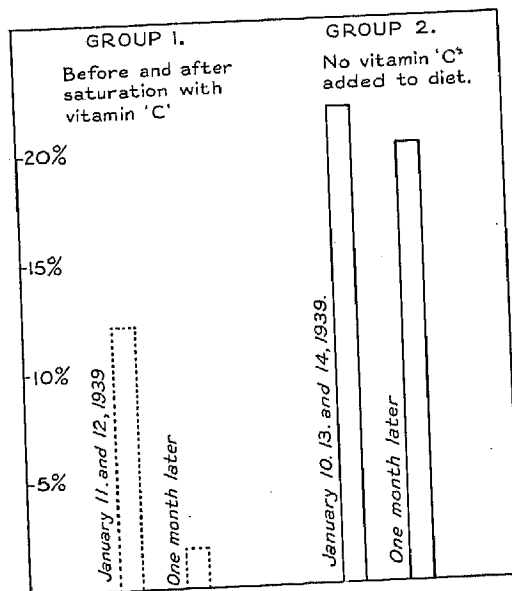


CHART 2.—Incidence of gingivo-stomatitis in new recruits.

ease of administration, these new recruits were saturated with vitamin C as before, and then kept on a maintenance dose of 50 mgm. daily per boy. The remainder of the new recruits, allotted to other divisions of the

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TABLE I.—59 NEW RECRUITS EXAMINED ON JANUARY 11 AND 12, 1939, AND THEN SATURATED WITH VITAMIN C.

Town of origin of recruit	Condition of mouth on entry	Condition of mouth one month later, after saturation with vitamin C
1. Winlaton	General inflammatory condition of gums and mucous membranes	Mouth now normal
2. Wingate	Marginal gingivitis. Tartar present. Does not use brush	Improved. Some marginal gingivitis still present
3. W. Hartlepool	Congestion of gums and mucous membranes. Gingivo-stomatitis. Tartar present around lower incisors	Mouth now normal
4. Newcastle	Marginal gingivitis. Dirty mouth	Improved since cleaning
5. Middlesbrough	Marginal gingivitis round upper incisors. Mouth breather. Hyperplasia	Much improved. Puckering of gums which are still thickened. No congestion now present
6. Dumbarton	Marginal gingivitis. Tartar present	No change. Is not cleaning teeth
7. Buckie	Marginal gingivitis	Much improved since cleaning
8. Dunfermline	Congestion of gums with some hyperplasia. Spongy appearance. Gingivo-stomatitis	Mouth now normal
9. Newcastle	Hyperplasia with sponginess and congestion. Gingivo-stomatitis	Mouth now normal
10. Perth	Marginal gingivitis	No change
11. Montrose	Congestion with hyperplasia. Spongy. Gingivo-stomatitis	Mouth now normal
12. Newcastle	Congestion and sponginess of gums. Dirty mouth. Gingivo-stomatitis	Marked improvement, but mouth still dirty and some marginal gingivitis present
13. Kirkcaldy	General congestion of gums with sponginess. Does not use brush. Gingivo-stomatitis	Some improvement. This boy escaped saturation with vitamin C owing to a dislike of cocoa; subsequent administration healed the condition

### *Summary.*

*January 11 and 12.*

59 recruits examined	Percentage of marginal gingivitis .. ..	10.2 per cent.
	Percentage of gingivo-stomatitis .. ..	11.8 per cent.
	Total .. ..	= 22 per cent.

*One month later.*

59 recruits after saturation with vitamin C	Percentage of marginal gingivitis .. ..	8.5 per cent.
	Percentage of gingivo-stomatitis .. ..	1.7 per cent.*
	Total .. ..	= 10.2 per cent.

\* This represents one case, a boy who escaped saturation with vitamin C owing to a dislike of cocoa. Subsequently saturation was achieved and the gums healed.

TABLE II.—90 RECRUITS EXAMINED ON JANUARY 10, 13 AND 14, 1939.  
NO VITAMIN C GIVEN.

Town of origin of recruit	Condition of mouth on entry	Condition of mouth one month later
1. Laurencekirk	Marginal gingivitis. Does not use brush	Healthy since using toothbrush
2. Aberdeen	Marginal gingivitis with some tartar present. Hyperplasia	Healthy after scaling and cleaning
3. Renfrew	Marked congestion of gums and mucous membranes. Gingivostomatitis. A mouth breather	No change
4. Aberdeen	Congestion with sponginess of gums. Gingivostomatitis	No change
5. Hamilton, Canada	Marginal gingivitis with hyperplasia. Dirty mouth	No change
6. Glasgow	Marginal gingivitis	No change
7. Dundee	Gums generally inflamed. Tartar around lower incisors. Gingivostomatitis	Improved following routine dental treatment
8. Newcastle	Congestion with hyperplasia. Tartar present. Gums spongy. Gingivostomatitis	Improved since cleaning, but still congested and hyperplastic
9. Edinburgh	Congestion of gums and mucous membranes of mouth	No change
10. Stockton-on-Tees	Spongy and congested. Gingivostomatitis	No change
11. Newcastle	Marginal gingivitis. Dirty mouth	No change
12. Wingate	Spongy and congested, with a gelatinous feel. Gingivostomatitis	No change
13. Newcastle	Congestion of gums and mucous membranes with some sponginess. Gingivostomatitis	No change
14. Berwick	Marginal gingivitis	Improved since brushing
15. Galashiels	Hyperplasia with marginal gingivitis	No change
16. Edinburgh	Congestion with hyperplasia and marginal gingivitis. Gingivostomatitis	No change
17. Aberdeen	Congestion with hyperplasia. Mouth dirty. Gingivostomatitis	Slight improvement since brushing. Gingivostomatitis still present
18. Newcastle	Congestion with hyperplasia. Dirty mouth. Gingivostomatitis	No change
19. Bishops Auckland	Marginal gingivitis	No change
20. Gateshead	Marginal gingivitis	No change
21. Sunderland	General congestion with a dirty mouth and marginal gingivitis. Gingivostomatitis	Improved since brushing, but gingivostomatitis still present
22. Crossgates	Marginal gingivitis. Dirty mouth	Normal since cleaning
23. Inverkeilou	Congestion with some hyperplasia and a dirty mouth	Improved since cleaning
24. Renfrew	Congestion with some hyperplasia and sponginess. Dirty mouth. Gingivostomatitis	Improved since cleaning, but gingivostomatitis persists
25. W. Hartlepool	Congestion with sponginess. Dirty mouth. Gingivostomatitis	No change

TABLE II.—*Continued.*

Town of origin of recruit	Condition of mouth on entry	Condition of mouth one month later
26. Islington	Marginal gingivitis. Dirty mouth	Improved
27. Glasgow	Marginal gingivitis. Dirty mouth	Improved
28. Sunderland	Congested and spongy. Mouth dirty and neglected	Mouth cleaned but no change in gum condition
29. Aberdeen	Congested with some hyperplasia. Gelatinous appearance and feel. Gingivo-stomatitis	No change
30. Aberdour	Marginal gingivitis. Dirty mouth	No change
31. Lochaber	Congestion of gums and mucous membrane. Gums spongy. Gingivo-stomatitis. Teeth clean and healthy	No change
32. W. Hartlepool	Congestion and sponginess. Gingivo-stomatitis	No change
33. Aberdeen	Congestion with hyperplasia. Mucous membrane of mouth congested. Gingivo-stomatitis	No change
34. Kirkcaldy	Some hyperplasia. Tartar present	Improved with cleaning

*Summary.**January 11, 13 and 14, 1939.*

90 recruits examined	Percentage of marginal gingivitis .. ..	15.5 per cent.
	Percentage of gingivo-stomatitis .. ..	22.2 per cent.
	Total .. ..	= 37.7 per cent.

*One month later.*

90 recruits examined. No vitamin C given	Percentage of marginal gingivitis .. ..	7.7 per cent.
	Percentage of gingivo-stomatitis .. ..	20.0 per cent.
	Total .. ..	= 27.7 per cent.

establishment, were watched as a control Group. Notes were taken at the time of the examination of each case of gum disease found.

Thus, while with ordinary routine dental treatments and cleaning the marginal gingivitis has been much reduced, the gingivo-stomatitis remains at practically the same level. Chart 2 illustrates the difference in the incidence of the gingivo-stomatitis in the two groups. It is perhaps unfortunate that the control group had a far higher percentage of gingivo-stomatitis at the commencement than the vitamin C group: the recruits are allotted to the various divisions indiscriminately, and neither the Medical nor Dental Authorities control their distribution. It will be seen, however, that the gingivo-stomatitis has been abolished in the vitamin C group, with the exception of one case, who escaped saturation.

## DISCUSSION.

From a study of these results there can be little doubt that the condition of marginal gingivitis is due to accumulation of food debris and tartar deposit, associated with lack of oral hygiene, and that improvement in personal cleanliness and routine dental treatment will in the majority of cases lead to a cure. The most energetic measures of this type,

however, fail to cause any change in the commonest lesion observed amongst these boys, which is a gingivo-stomatitis clearly associated with hypovitaminosis C; for investigations upon actual cases have in every instance shown a deficiency in this factor, and saturation with ascorbic acid has never failed to effect a cure. Boys in the control group with gingivo-stomatitis were subsequently treated with vitamin C, and usually within 14 days a characteristic colour change was observed, the gums losing their deep red, almost maroon colour, the tissues becoming firmer, and assuming their normal pink appearance.

Kramer (1937) investigated 34 cases of gingivitis and stomatitis for vitamin C deficiency according to the method of Jezler and Niederberger (1936). A deficiency varying from 2,000 to 2,500 mgm. was observed in each case, and treatment with "Redoxon" (Roche Products) effected a cure in each case except one. He was particularly impressed by a general improvement in general health which followed saturation, not only did the gums become firmer and the hæmorrhage cease, but symptoms such as lassitude, anorexia and rheumatic pains in the limbs also cleared up. Altogether he found that 20% of the army personnel suffered from C-hypovitaminosis, and that the incidence of prescorbutic conditions such as lassitude and pains in the limbs was higher during the winter months, a finding which supports the observation that exposure to damp and cold accelerates the development of scurvy in subclinical cases, and is the reason why scurvy was once thought to be due to exposure, as rheumatism is to-day by some.

No cases were observed of hæmorrhage from the gums amongst these boys; but symptoms such as lassitude and "rheumatic growing pains" were quite common, and positive tourniquet tests were obtained in some. The pains disappeared usually on saturation. The group receiving the vitamin volunteered the information that their appetites had improved, and that they slept better.

This association of gingivitis and rheumatic pains is of great interest. The relation of dental pathology to the adult type of chronic rheumatism has long been recognized, and a deficiency gingivo-stomatitis, such as is described above, must predispose to dental sepsis and decay in later years. As already noted, the mucosal congestion in these cases usually extended backwards, involving the tonsils and the upper part of the pharynx; and it is to be expected that an unhealthy mucosa would fall an easy prey to streptococcal infection. The "growing pains" associated with vitamin C deficiency occur in and around the larger joints, such as the ankle, shoulder, but more commonly the knee. They tend to become worse as the day wears on, and are more noticeable in certain actions, such as climbing stairs. At night time they disappear, and are usually not present on waking in the morning. In these cases sedimentation rates are normal,



and no pyrexia occurs. Exactly similar symptoms may be complained of in cases where there is also evidence of infection, such as an increased sedimentation rate, or pyrexia; in these cases the pains appear to be more constant, and may occur at night. Cases of this nature may later develop rheumatic fever, with true arthritis; or carditis may develop "silently" without any further manifestations of rheumatism. It is often impossible to differentiate from the description of the symptoms by the patient a case which will clear up on saturation with vitamin C, from one which will tend to progress to rheumatism and carditis. Clinical examination may be of no value, the sedimentation rate helps us to come to a decision, but unfortunately it is not infallible.

Bearing the above considerations in mind, it is interesting to discover that 43.5 per cent. of the cases of gingivitis were recruited from Tyneside and surrounding district, whereas of the total number of recruits only 21 per cent. came from this area. On conducting a similar investigation into cases of rheumatic fever, we were not surprised to find that by far the heaviest incidence of rheumatism fell upon recruits from the Tyneside. This question is considered fully in another paper, and we do not wish to deal with it at length here, but it is well known that economic conditions on Tyneside are below the standard for the country as a whole, and it is probable that dietetic deficiencies have existed amongst many of the recruits from this area since birth.

#### SUMMARY.

Advantage has been taken of a trial of the addition of vitamin C to the diet of boys in a training establishment of the Royal Navy to observe the effects of saturation upon gum lesions. The commonest lesion observed, a gingivo-stomatitis, was abolished by the use of the vitamin. The most energetic treatment of recruits leaves a residuum of gum disease in those not saturated with ascorbic acid. Marginal gingivitis, on the other hand, usually responds to simple hygienic measures. The incidence of gingivitis fell more heavily on Tyneside recruits, and these recruits were more prone to develop rheumatic fever.

We are greatly indebted to Surgeon Captain Vickery, O.B.E., R.N., for his help and encouragement in the initial stages of this work. We must express our thanks to Messrs. Roche Products, Ltd., for generous supplies of ascorbic acid, "Redoxon" brand, which has rendered this trial possible.

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