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PREVALENCE OF ANGULAR STOMATITIS
CORRELATION WITH COMPOSITION OF FOOD AND METABOLISM OF VITAMINS AND IRON

by

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INTRODUCTION

The condition characterized by rhagades at the corners of the mouth has been given various names in the literature, such as angular cheilosis, angular or commissural cheilitis, angular stomatitis and perlèche. *Finnerud* (1929), who showed that fungal infection could cause perlèche, used the terms angulus infectiosus and impetigo commissural. *Marcussen* (1944) listed further names: angulus vitiosus, niarde, pourlèche, bridou, poissonade, faulecke and faulwinkel. In the dental literature, the most common term is apparently angular cheilosis, but *Bicknell* and *Prescott* (1953) recommend the term angular stomatitis, since cheilosis is a lesion of the vermilion of the lip. There are two different types of angular stomatitis, one produced by endogenous, the other by exogenous factors, called by *Nyquist* (1962) the genuine and the pseudo angular cheilitis. The former causes transverse rhagades and is strictly restricted to the corners of the mouth, while the latter forms a deep, macerated and inflamed fold with an oblique downward course in the labiomental sulcus.

The etiology of angular stomatitis is not quite clear yet. The condition is known to be one of the symptoms of riboflavin deficiency. Similar lesions can, however, be seen in subjects with no other symptoms of ariboflavinosis, such as cheilosis, ocular or seborrhealike lesions, whose laboratory tests

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reveal no signs of avitaminosis and who have had sufficient riboflavin intakes (*Ellenberg & Pollack*, 1942). No ariboflavinotic eye symptoms were detected in *Marcussen*'s (1944) series of 100 patients with angular stomatitis. It is therefore not suprising that angular stomatitis has often been resistant to riboflavin therapy (*Ellenberg & Pollack*, 1942; *Machella*, 1942; *Machella & McDonald*, 1943). Some cases healed with ascorbic acid (*Machella*, 1942), which would suggest a scorbutic etiology. Pantothenic acid and pyridoxine have also sometimes given favourable results (*Smith & Martin*, 1940; *Machella & McDonald*, 1943; *Field et al.*, 1945).

The anaemia often concomitant with angular stomatitis has aroused attention (*Witts*, 1931; *Smith & Martin*, 1940; *Marcussen*, 1944; *Rose*, 1968). Since it is known that anaemia may be produced by a deficiency of e.g. iron, thiamine, pantothenic acid, folic acid and ascorbic acid, many systemic, particularly nutritional factors may contribute towards the development of angular stomatitis.

Angular stomatitis is often combined with loss of teeth and the wearing of full dentures, especially ill fitting full dentures. In the series presented by *Ellenberg & Pollack* (1942), 91 per cent of the patients with angular stomatitis had complete dentures in both the upper and lower jaw. The corresponding figure for *Rose*'s (1968) series was 70 per cent. *Nyquist*'s (1962) series comprised 1093 patients with full dentures, 30 per cent of whom had angular stomatitis. Decreased occlusal vertical dimension is considered to be one of the major causes of angular stomatitis (*Nyquist*, 1962); this dimension is very often decreased especially in wearers of old complete dentures. The overclosure of the mouth develops deep furrows at the corners of the mouth, which become macerated in the presence of saliva, with resulting inflammatory changes. *Neill* (1963) reported on 26 patients with angular stomatitis, of whom only 15 per cent had a freeway space of 4 mm or more, while in another 15 per cent no freeway space at all could be shown. *Turrell* (1968) did not believe that the decreased occlusal vertical dimension was a common cause of angular stomatitis, since the lesion healed in most of his 97 patients after a fortnight without dentures, despite the fact that the vertical dimension was naturally even smaller in this way.

Poyton (1955) cured angular stomatitis in a week by adjusting the position of the upper anterior teeth on a denture where they had been placed too far back causing depression of the corners of the mouth and consequent leakage of saliva.

Another cause reported for angular stomatitis was sensitivity to denture material, mouth washes and lipstick (*Ellenberg & Pollack*, 1942; *Marcussen*, 1944).

Finnerud (1929) was able to infect a child with angular stomatitis from a second child and proved that there was a fungal infection in these cases. Many other authors have subsequently found *Candida albicans* or morphologically and culturally similar yeasts in angular stomatitis (*Lyon & Chick*, 1957; *Shuttleworth & Gibbs*, 1960; *Cawson*, 1963; *Neill*, 1963; *Lehner*, 1965), a finding these same authors made in denture stomatitis (denture sore mouth, DSM). DSM and angular stomatitis frequently coincide (*Lyon & Chick*, 1957; *Chick*, 1962; *Cawson*, 1963 and 1965), and fungistatic and fungicidal chemotherapeutics have often been succesful in their treatment (*Neill*, 1963; *Shuttleworth & Gibbs*, 1960; *Lorber*, 1965).

Since the oral administration of certain antibiotics may change the microflora of the mouth so as to increase the relative share of yeasts, the question has arisen whether this may cause angular stomatitis. *Tomaszewski* (1951), who studied the side effects of chloramphenicol and aureomycin found from tongue scrapings that the bacterial flora had disappeared and the fungal flora (mostly *Candida albicans*) increased. Angular stomatitis developed in 11 per cent of the 70 patients treated with chloramphenicol and in 12 per cent of the 56 treated with aureomycin. Tetracycline has not been found to increase the Candida population of the mouth (*McKendrick et al.*, 1967) or the prevalence of angular stomatitis (*McKendrick*, 1968).

Candida is normally present in the mouth but the population may increase remarkably with a high intake of carbohydrates, for these micro-organisms are essentially glycolytic. For this reason, diet, and oral and denture hygiene may play a part in the development of angular stomatitis.

From the above review of the literature it may be concluded that the etiological factors in angular stomatitis may consist of nutritional disorders (vitamin and iron deficiency, indirectly a high intake of refined carbohydrates), fungal infection, occlusal disharmony (malocclusions, decreased occlusal vertical dimension, ill fitting or technically unsatisfactory dentures), and allergic conditions, either individually or in different combinations.

The present study was concerned with the prevalence of angular stomatitis in patients wishing to have artificial dentures made, as well as its correlations with the composition of the food consumed, and with vitamin and iron metabolism. An abbreviation, AS, will be used for angular stomatitis.

MATERIAL AND METHODS

The series comprised a total of 339 patients of the Department of Prosthetics, Institute of Dentistry, University of Turku, and of the Turku Full Denture

Table I.

The material

	Patients of the Institute of Dentistry, University of Turku						Patients of the Turku Full Denture Clinic		
	Spring term			Autumn term					
	M	F	T	M	F	T	M	F	T
Number of subjects	19	21	40	17	21	38	110	151	261
Median age, years	54	48	50	54	59	56	55	52	54
Age range	27–72	19–73	19–73	21–82	18–78	18–82	20–83	21–83	20–83

(M = male, F = female, T = total)

Clinic (Table I). These patients were edentulous, in either one jaw or both jaws, and wished to have complete upper and/or lower dentures made. All could be considered to have decreased occlusal vertical dimension. The age median of the series was 54 years (range 18—83). There were 146 men aged 20—83 years (median 54 years) and 193 women aged 18—83 years (median 53 years). The patients were examined at their first visit; their age was recorded as was their sex, the edentulous period, remaining teeth, earlier dentures made and their age, DSM, oral hygiene and AS. The patient was considered to have DSM if the oral mucosa bearing the upper or lower denture showed chronic inflammatory changes. Oral hygiene was considered poor if food debris was seen in the edentulous mouth or if the earlier dentures were not cleaned showing impurities on the outer or inner surface or between the teeth. Poor oral hygiene was also recorded for patients whose remaining teeth were badly cleaned from plaque and food debris or who had supragingival calculus. Table II presents the series by age groups, classified according to their oral conditions.

No difference was made between the genuine and pseudo form of AS. All patients in whom one or both corners of the mouth showed macerated, reddened fissures were classified as having AS. Bilateral and unilateral changes were recorded separately. The Chi square test was used to study the correlations between the incidence of AS and the patients' sex, age, oral hygiene, wearing of dentures, type of dentures and duration of their wear, DSM, edentulous period and the season of the year.

The food intake of the patients of the Institute of Dentistry was studied by personal clinical food interviews made by one and the same person (the

Table II.

Numerical distribution of the series according to age and sex in various oral conditions

Age	Total series			Edentulous			Natural teeth in one jaw			Wearing earlier dentures			Denture sore mouth			Poor oral hygiene			Edentulous without dentures			Wearing earlier full upper and lower dentures		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
18—29	9	18	27	4	8	12	5	10	15	—	4	4	—	1	1	3	5	8	4	6	10	—	1	1
30—39	13	26	39	7	9	16	6	17	23	3	9	12	2	2	4	7	5	12	5	5	10	—	1	1
40—49	32	45	77	24	35	59	8	10	18	8	21	29	5	14	19	9	12	21	18	14	32	1	3	4
50—59	47	41	88	37	33	70	10	8	18	14	29	43	5	17	22	12	15	27	27	10	37	5	12	17
60—69	30	44	74	20	35	55	10	9	19	17	33	50	7	14	21	10	15	25	8	8	16	5	14	19
70—83	15	19	34	13	16	29	2	3	5	7	13	20	3	5	8	5	7	12	7	3	10	3	6	9
Total	146	193	339	105	136	241	41	57	98	49	109	158	22	53	75	46	59	105	69	46	115	14	37	51

(M = male, F = female, T = total)

writer) (*Leitch & Aitken*, 1950; *Young*, 1959). Intakes of vitamin A, thiamine, riboflavin, niacin, ascorbic acid and iron were calculated from the data obtained, using the Finnish food composition tables by *Turpeinen* and *Roine* (1967), while the intakes of pantothenic acid and folic acid were calculated on the basis of data collected from several sources (*Bicknell & Prescott*, 1953; *Sebrell & Harris*, 1954; *Wohl & Goodhart*, 1964).

The intake of refined carbohydrates was estimated on the basis of the consumption of sugar, buns, and sweets. If the test subject ate more sugar than the equivalent of 20 ordinary lumps a day, ate a minimum of six buns or slices of sweet wheat bread a day, or ate sweets daily, he was considered to live on a diet containing plenty of refined carbohydrates.

From the fasting serum of the 40 patients during spring term, the thiamine was determined by the simplified thiochrome method (*Myint & Houser*, 1965), the free riboflavin together with the flavin mononucleotide (FMN), and the flavin adenine dinucleotide (FAD) by the fluorometric micromethod described by *Burch et al.* (1948), the folic acid by the microbiological method using *Lactobacillus casei* (*Waters & Mollin*, 1961), and the ascorbic acid by the dinitrophenylhydrazine micromethod (*Lowry et al.*, 1945). The haemoglobin of the 38 patients of the autumn term was determined by the cyanmethaemoglobin method, the vitamin A and carotene by the trifluoroacetic acid method (*Neeld & Pearson*, 1963), the pantothenic acid by the microbiological method using *L. plantarum* as the micro-organism (*Skeggs & Wright*, 1944), and the iron by the orthophenanthroline method (*Barkan & Walker*, 1940), all from the fasting serum. The serum values and intake of trace nutrients in the patients with AS, and their haemoglobin values were compared, by means of Student's t-test, with the corresponding levels of a control group consisting of all the subjects with healthy corners of the mouth, 29 in the spring and 32 in the autumn term.

The 17 patients with AS of the series collected from the Institute of Dentistry were invited to a follow-up examination 12 months later, by which time they had worn their new dentures for 8—12 months. The attendance was 13 patients (76 per cent), with 8 spring term and 5 autumn term patients. The intake of vitamins and iron, and the serum values of vitamins and iron were re-determined for all of them. When data obtained on a patient at the initial and follow-up examinations were compared, the inter-individual differences were recorded, and the signs and the quantities of the differences were taken into account using the Wilcoxon matched-pairs signed-ranks test. In the study of the changes in consumption of refined carbohydrates only the sign of the change was taken into account, and the sign test was applied.

Table III.

Distribution of patients with angular stomatitis (AS) according to age and sex in various oral conditions

Age	All AS patients			Edentulous			Natural teeth in one jaw			Wearing earlier dentures			Denture sore mouth			Poor oral hygiene			Edentulous without dentures			Wearing earlier full upper and lower dentures		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
18—29	—	5	5	—	4	4	—	1	1	—	2	2	—	1	1	—	—	—	—	2	2	—	1	1
30—39	2	4	6	—	3	3	2	1	3	1	4	5	1	2	3	1	1	2	—	—	—	—	1	1
40—49	5	9	14	5	8	13	—	1	1	1	7	8	1	5	6	2	3	5	4	1	5	—	3	3
50—59	6	10	16	6	9	15	—	1	1	2	9	11	2	6	8	2	6	8	4	1	5	1	2	3
60—69	3	9	12	2	7	9	1	2	3	2	9	11	2	5	7	1	4	5	—	—	—	2	5	7
70—83	2	6	8	2	5	7	—	1	1	—	6	6	—	3	3	1	4	5	2	—	2	—	3	3
Total	18	43	61	15	36	51	3	7	10	6	37	43	6	22	28	7	18	25	10	4	14	3	15	18
Per cent	12	22	18	14	26	21	7	12	10	12	34	27	27	42	37	15	31	24	14	9	12	21	41	35

(M = male, F = female, T = total)

RESULTS

Prevalence of Angular Stomatitis

Total series

Table III gives the numbers of the AS patients classified according to age, sex and oral conditions. The total number of AS patients in the series was 61 (18 per cent), 18 men and 43 women. 12.3 per cent of all the men of the series, and 22.3 per cent of the women were therefore affected with AS (Fig. 1). In women the AS thus was more frequent than in men ($\varkappa^2 = 4.92$; $P<0.05$). 42.6 per cent of all the cases of AS were unilateral, 50 per cent in men and 39.5 per cent in women; P = . . (Table IV). The incidence of AS was very closely connected with the wearing of dentures. 27.2 per cent of denture wearers had the disease, but only 9.9 per cent of those without dentures ($\varkappa^2 = 15.90$; $P<0.0005$) (Fig. 2). In completely edentulous persons the AS was more frequent than in subjects with one or more natural teeth in either jaw ($\varkappa^2 = 4.95$; $P<0.05$). Oral hygiene and age did not affect the incidence

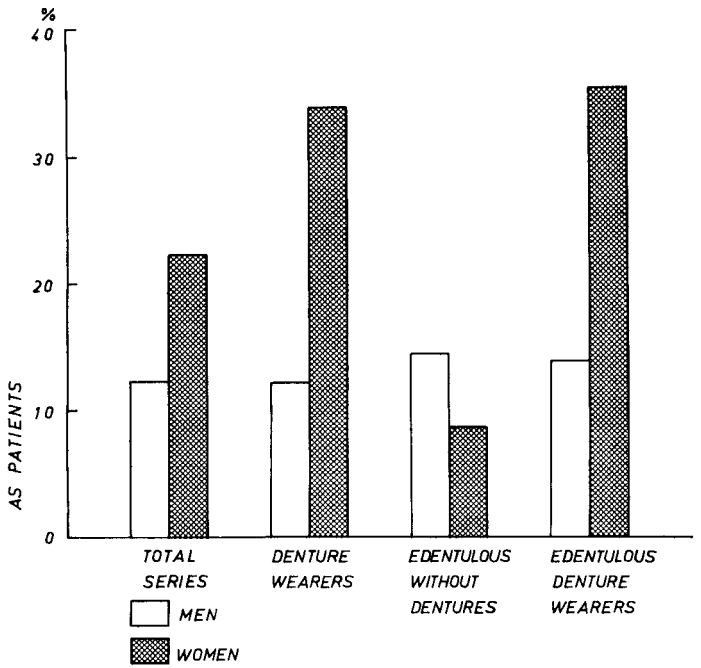

Fig. 1. Percentages of angular stomatitis (AS) among male and female patients.

Table IV.

Bilateral and unilateral prevalence of angular stomatitis (AS) according to age group and sex

Age	Bilateral			Unilateral		
	M	F	T	M	F	T
18—29	—	2	2	—	3	3
30—39	1	1	2	1	3	4
40—49	2	6	8	3	3	6
50—59	2	5	7	4	5	9
60—69	2	8	10	1	1	2
70—83	2	4	6	—	2	2
Total	9	26	35	9	17	26
Per cent	50	60	57	50	40	43

(M = male, F = female, T = total)

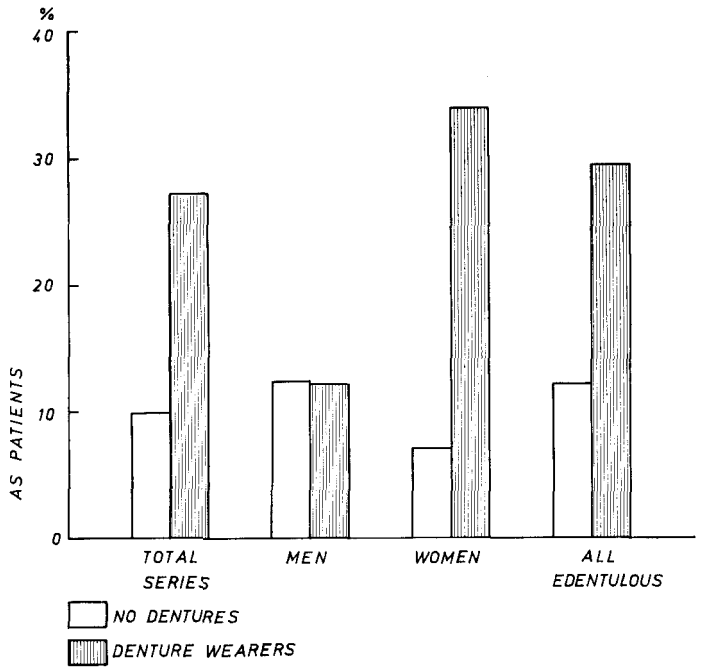

Fig. 2. Percentages of angular stomatitis (AS) among patients with and without dentures.

Table V.

Numbers and percentages of patients with angular stomatitis (AS) in the total series

		Number of subjects	AS patients	
			Number	Per cent
Sex	men	146	18	12.3
	women	193	43	22.3
Age, years	18—39	66	11	16.7
	40—59	165	30	18.2
	60—83	108	20	18.5
Oral and denture hygiene	good	234	36	14.8
	poor	105	25	23.8
Natural teeth left	yes	98	10	10.2
	no	241	51	21.2
Wearing earlier dentures	yes	158	43	27.2
	no	181	18	9.9

of AS when the total series was reviewed. Table V gives the numerical and percentage incidence of AS in the total series.

Of the 85 patients examined during the summer months (May—August), 11 (12.9 per cent), and of the 144 examined in the winter months (November —March) 31 (21.5 per cent) had AS (P = ..). 15 per cent of the June—November patients and 20.9 per cent of the December—May patients had AS (P = . .).

Since the prevalence of AS seemed to differ between the sexes, its occurrence was also studied separately. It was found that men without dentures had AS as frequently (12.4 per cent) as men wearing dentures (12.2 per cent). The corresponding figures for women were 7.1 and 33.9 per cent, respectively (Fig. 2), a difference which was statistically highly significant ($\varkappa^2 = 18.16$; $P<0.0005$).

Of the women examined in the winter, 29.3 per cent had AS, but in the summer only 10.5 per cent ($\varkappa^2 = 4.10$; $P<0.05$). The corresponding figures for men were 11.3 and 16.7 per cent (P = . .).

Denture wearers

When the wearers of earlier dentures were reviewed as a separate group, the prevalence of AS among both sexes revealed a similar (higher among women than men) but more pronounced difference than in the total series ($\varkappa^2 = 6.98$;

Table VI.

Numbers and percentages of patients with angular stomatitis (AS) among wearers of earlier dentures

		Number of subjects	AS patients	
			Number	Per cent
Sex	men	49	6	12.2
	women	109	37	33.9
Age, years	18—39	16	7	43.7
	40—59	72	19	26.4
	60—83	70	17	24.3
Denture hygiene	good	97	24	24.7
	poor	61	19	31.1
Natural teeth left	yes	32	6	18.7
	no	126	37	29.4
Age of dentures*	2 yrs or less	16	2	12.5
	over 2 yrs—5 yrs	22	6	27.3
	over 5 yrs—10 yrs	46	13	28.3
	over 10 yrs	62	21	33.9
Type of denture	full upper and lower	51	18	35.3
	other	107	25	23.4
Denture sore mouth	yes	75	28	37.3
	no	83	15	18.1

* Information not obtained from 12 subjects

$P<0.005$) (Fig. 1). The prevalence of AS was higher in subjects with inflamed (DSM) than with intact denture-bearing mucosa ($\chi^2 = 6.43$; $P<0.025$). No statistically significant difference was recorded between age groups and patients with differing denture hygiene, or between dentures of different periods of wear or different type (full upper and lower, or other), although the percentage of AS prevalence seemed to increase as dentures became older (Table VI). The lesion was unilateral in 34.9 per cent of the denture wearers with AS. The corresponding figure for those with no denture was 61.1 per cent ($P = ..$).

46.1 per cent of the female denture wearers aged 18—39 years had AS. The corresponding percentages for age groups 40—59 and 60—83 years were 32.0 and 32.6. The prevalence rates of AS in men of identical age groups were 33.3, 13.6 and 8.3 per cent. The differences in prevalence between age groups were not statistically significant.

Table VII.

Numbers and percentages of patients with angular stomatitis (AS) in the different groups of edentulous subjects

		All edentulous			Edentulous without dentures			Edentulous denture wearers		
		Number of	AS patients		Number of	AS patients		Number of	AS patients	
		subjects	Number	Per cent	subjects	Number	Per cent	subjects	Number	Per cent
Sex	men	105	16	14.3	69	10	14.5	36	5	13.9
	women	136	36	26.5	46	4	8.7	90	32	35.5
Age, years	18—39	28	7	25.0	20	2	10.0	8	5	62.5
	40—59	129	28	21.7	69	10	14.5	60	18	30.0
	60—83	84	16	19.0	26	2	7.7	58	14	24.1
Oral and denture hygiene	good	183	30	16.4	99	10	10.1	84	20	23.8
	poor	58	21	36.2	16	4	25.0	42	17	40.5
Wearing earlier dentures	yes	126	37	29.4	—	—	—	126	37	29.4
	no	115	14	12.2	—	—	—	—	—	—
Edentulous period*	under 3 months	—	—	—	63	8	12.7	—	—	—
	3—6 months	—	—	—	28	5	17.8	—	—	—
	over 6 months	—	—	—	20	1	5.0	—	—	—

* Information not obtained from 4 subjects

Edentulous subjects

The edentulous women also had a higher incidence of AS than the men ($\varkappa^2 = 4.57$; $P<0.05$) (Fig. 1). Age did not affect the occurrence of AS even among the edentulous subjects. The AS was more frequent in the edentulous wearing earlier dentures than in those with no dentures ($\varkappa^2 = 9.65$; $P<0.005$), more frequent in the edentulous who had neglected their oral hygiene than those with good oral hygiene ($\varkappa^2 = 9.21$; $P<0.005$) (Table VII and Fig. 3). The correlation of the edentulous period with the prevalence of AS was studied from the edentulous subjects without dentures. The results are shown in Table VII. The differences between the observations concerning the various groups were not statistically significant. The edentulous without dentures showed no statistically significant difference in the prevalence of AS between the sexes, between age groups or in different hygienic conditions of the mouth (Table VII).

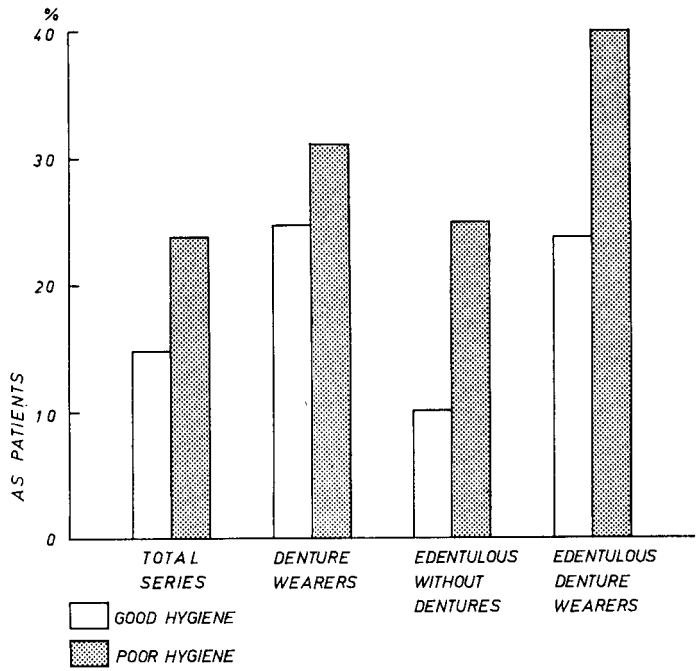

Fig. 3. Percentages of angular stomatitis (AS) among patients with different oral and denture hygiene.

The edentulous subjects wearing earlier dentures were also examined as one group, and again women were found to have AS more frequently than men ($\varkappa^2 = 4.82$; $P<0.05$) (Fig. 1). The age or oral hygiene could not be shown to affect statistically significantly the prevalence of AS among edentulous denture wearers (Table VII).

Haematological Studies

Table VIII shows the mean haemoglobin values of the AS patients and the control subjects, and also their mean serum iron and vitamin levels, and standard deviations. In subjects affected with AS the serum thiamine ($t = 2.14$; $P<0.05$) and free riboflavin + FMN values ($t = 2.50$; $P<0.02$) were lower than in the controls. The mean values of haemoglobin, serum iron, vitamin A, carotene, pantothenic acid, folic acid and ascorbic acid, on the other hand, showed no statistical differences between the AS group and the controls. In six cases the haemoglobin value was below 12.5 g %, and two of these patients had AS.

Table VIII.

Serum levels of the studied trace nutrients and haemoglobin values

	Angular stomatitis (AS) group			Control group		
	Number of subjects	Mean	S.D.	Number of subjects	Mean	S.D.
Serum vitamin A (μg%)	6	27.25	12.64	30	26.95	9.90
» carotene (μg%)	6	28.92	12.95	30	29.22	12.34
» thiamine (μg%)	11	0.55*	0.99	29	1.23	1.59
» riboflavin						
FAD (μg%)	11	1.07	0.78	29	1.35	0.67
Free + FMN (μg%)	11	0.30**	0.29	29	0.57	0.33
» pantothenic acid (μg%)	6	361.13	184.90	32	358.25	184.20
» folic acid (μg%)	11	0.57	0.24	28	0.70	0.98
» ascorbic acid (mg%)	11	0.72	0.39	28	0.61	0.54
» iron (μg%)	6	122.67	37.17	32	108.45	37.08
Haemoglobin (g%)	6	13.10	0.82	32	13.71	1.11

* Significant at 5 per cent level

** Significant at 2 per cent level

Dietary Studies

Table IX shows the mean weekly dietary intakes of iron and vitamins in both groups. The intake of iron in the AS patients was lower than in the controls ($t = 2.44$; $P<0.02$), while the vitamin intakes hardly differed at all.

Thirteen (76.5 per cent) of the 17 patients with AS had high refined carbohydrate intakes. The corresponding figure among 60 subjects with healthy corners of the mouth was 33 (55 per cent).

Follow-up Examinations of AS Patients

Three of the 13 patients who had AS and attended the follow-up examination were still affected with the same disease. In two of them the occlusal vertical dimension of the dentures was found to be too low. The corners of the mouth of 10 subjects had healed completely. Two of the ten even had dentures with a decreased occlusal vertical dimension.

A review of the changes in serum iron and vitamin values of those attending the follow-up examination revealed a statistically significant rising trend for thiamine ($P<0.02$) and free riboflavin + FMN ($P<0.02$), and a declining trend for folic acid ($P<0.05$) (Table X).

Table IX.

Dietary intake of vitamins and iron

Nutrient	Angular stomatitis (AS) group			Control group		
	Number of subjects	Mean	S.D.	Number of subjects	Mean	S.D.
Vitamin A (I.U./week)	6	15095	8601	29	18208	6175
Thiamine (mg/week)	11	6.2	2.1	29	6.4	2.4
Riboflavin (mg/week)	11	13.9	5.7	29	13.4	5.8
Niacin (mg/week)	11	42.9	13.8	29	41.6	19.3
Pantothenic acid (mg/week)	6	48.8	24.3	30	44.6	21.6
Folic acid (mg/week)	11	1.05	0.39	29	0.97	0.43
Ascorbic acid (mg/week)	11	293	85	29	317	129
Iron (mg/week)	6	45.0**	17.4	31	65.3	23.8

** Significant at 2 per cent level

Table X.

Changes in serum level of trace nutrients in the re-examined angular stomatitis (AS) group after wearing dentures for 8—12 months

Serum level of	Number of persons whose serum level had		
	increased	decreased	not changed
Vitamin A	4	1	0
Carotene	5	0	0
Thiamine	7**	1	0
Riboflavin			
Free + FMN	7**	1	0
FAD	6	2	0
Pantothenic acid	1	4	0
Folic acid	1	6*	1
Ascorbic acid	6	2	0
Iron	0	5	0

** Significant at 2 per cent level
* Significant at 5 per cent level

Table XI.

Changes in dietary intake of trace nutrients in the re-examined angular stomatitis (AS) group after wearing dentures for 8—12 months

Nutrient	Number of persons whose dietary intake had		
	increased	decreased	not changed
Vitamin A	4	1	0
Thiamine	5	3	0
Riboflavin	5	3	0
Niacin	7*	1	0
Pantothenic acid	3	2	0
Folic acid	6	2	0
Ascorbic acid	7	1	0
Iron	4	1	0

* Significant at 5 per cent level

Table XI gives the numbers of the increases and decreases in the intake of trace nutrients. It can be seen that the intakes had increased more often than decreased. A significant rising trend, however, was only demonstrable for niacin ($P<0.05$).

The consumption of sugars had fallen in nine subjects, increased in two and remained unchanged in two. The sign test, therefore, could not show any statistically significant trend of change.

DISCUSSION

The higher prevalence of AS among women than men may be connected with hormonal factors. However, the age group 40—49 years, which coincides with the climacteric, showed no major difference in the incidence of AS in women (20 per cent) compared with the overall incidence of the other age groups (23 per cent), while the incidence was highest in the youngest (18—29 years) and the oldest (70—83 years) age groups examined (Tables III and IV). This finding, and the fact that the highest incidence of AS among denture-wearing women occurred in the youngest age group, suggests another systemic factor, iron deficiency anaemia. Iron deficiency anaemia is common in women, especially young women, and the coincidence of anaemia with AS was mentioned in the introduction. The haemoglobin was determined for the present study in only 38 patients, including three women with AS. Two of these three had haemoglobin values below 12.5 g %, which may be considered abnormal. Even though this is an arbitrary limit, it has been applied in most papers on anaemia (*WHO*, 1959). *Rose* (1968) found in his study that the mean levels of haemoglobin and plasma iron were significantly lower in the AS group than among the controls. Although the present study, with a smaller series, failed to lead to identical results, it by no means contradicts *Rose*, since the iron intakes in AS patients were lower than in the controls.

Also in *Nyquist*'s (1962) series, composed of patients with complete dentures, the prevalence of AS was higher in women (33 per cent) than in men (24.7 per cent). The difference, however, was not verified by statistical methods. The prevalence of AS obtained in the present study for women with dentures, 33.9 per cent, is almost identical with that reported by *Nyquist*, whereas the percentage obtained for men, 12.2 per cent, is only half that quoted by *Nyquist*. It is worth pointing out that *Nyquist* studied only the pseudo form of AS.

According to *Nyquist* (1962), the denture wearers with decreased occlusal vertical dimension had an incidence of pseudo angular cheilitis 39.7 per cent higher than those with the correct vertical dimension ($P<0.001$). The present study provided no information on the effect of decreased vertical dimension on the development of AS, since no control subjects for this particular purpose were included in the series. It may be concluded, however, that an even heavily decreased occlusal vertical dimension alone, without the presence of dentures, does not seem to form an important etiological factor for AS. This view is supported by the fact that the edentulous subjects without dentures had a statistically significantly lower prevalence (12.2 per cent) of AS than the edentulous denture wearers (29.4 per cent). A similar view is

encouraged by the finding that in the edentulous without dentures the duration of the edentulous period did not seem to affect at all the prevalence of AS.

In the present series, in which the occlusal vertical dimension of every subject was lowered, AS seemed much more infrequent in subjects without dentures than in those already wearing dentures. The dentures worn, by and large, were old — some 74 per cent of all denture wearers wore dentures which had been made more than 5 years previously. In most cases, therefore, the dentures were ill fitting and did cause DSM in 47 per cent of the cases. The prevalence of AS in connection with this condition was higher than in subjects with healthy denture-bearing mucosa. 33 per cent of the DSM patients in *Lyon* and *Chick*'s (1957) series were also affected with AS. *Cawson* (1963) reported a figure of 54 per cent from his study. The present result falls between these percentages: 37.3 per cent of the DSM patients had AS. AS concomitant with DSM has been found to disappear once the DSM is cured with fungicide (*Lyon & Chick*, 1957). According to *Nyquist* (1952), the principal cause of DSM was mechanical irritation by the denture, and when it is eliminated DSM may disappear. Whether AS then heals simultaneously is an open question. Efforts will be made to find an answer by means of a follow-up examination at a later date.

Only eight subjects from the whole series wore dentures which were less than five years old. This may have affected the calculations concerning the influence of the age of dentures on the incidence of AS. No statistically significant influence could be recorded, even though the percentages indicating the incidence of AS rose as the dentures grew older.

The finding that no significant difference was noted in the prevalence of AS between subjects with good and poor denture hygiene was unexpected. The explanation is perhaps that the oral and denture hygiene were assessed at the patient's first visit, for which he may have prepared himself carefully e.g. by rinsing his mouth and brushing his dentures. Even those who usually neglected their oral hygiene were thus recorded as having good hygiene. The higher prevalence of AS recorded for the whole edentulous group in connection with poor oral hygiene is perhaps due to the fact that poor oral hygiene is less frequent among the edentulous without dentures than those wearing dentures. This being so, a large number of denture wearers were referred to the group with poor oral hygiene than to that which took good care of their oral hygiene. Ultimately, the wearing of dentures may have decided the difference recorded between these groups in the incidence of AS. However, the percentages reflecting the incidence of AS were higher when the oral hygiene was poor than when good care was taken of the clean-

liness of mouth and dentures. It may be assumed that, had the groups of edentulous denture wearers and the edentulous without dentures been larger, statistical significance would have been reached on this point.

Since 72.5 per cent of the completely edentulous patients with AS wore dentures but only 60 per cent of those AS patients who had one or more natural teeth in one jaw, it may be presumed that the higher prevalence of AS recorded for the completely edentulous in the total series was due to the wearing of dentures.

A very interesting finding was that men wearing dentures had the same prevalence of AS as those without dentures, whereas the prevalence of AS in female denture wearers was highly significantly higher than in women with no dentures. A systemic factor peculiar to women may be assumed to predispose them to the development of AS. Another interesting feature here is that denture-wearing men had almost as high a prevalence of DSM (44.9 per cent) as the denture-wearing women (48.6 per cent).

Mann (1957) mentioned in a case report that AS had vanished in the summer and returned in the winter. A similar tendency was noticeable in the present results, although it was not statistically significant.

The intake of certain vitamins, such as vitamin A and C, is significantly lower in the winter and early summer, owing to the absence of fresh foods, than in the summer and autumn (*Pekkarinen*, 1962). The seasonal incidence of AS in the present study showed no differences, nor were there differences in the intake of these vitamins or their serum values in the comparison of AS patients with the control subjects.

The mean serum thiamine values in healthy subjects reported by *Carleen et al.* (1944), *Burch et al.* (1952), *Baker et al.* (1960), and *Myint & Houser* (1965) ranged from 0.69 to 2.1 μg%. Compared with these, the mean serum thiamine value of the present patients with AS seemed very low, whereas the values of the control subjects agreed better with the range quoted. Similarly, the mean serum value of free riboflavin + FMN in the AS group remained below the earlier means ranging from 0.68 to 0.92 μg% (*Burch et al.* 1948; *Suvarnakich et al.*, 1952; *Vavich et al.*, 1954; *Wilcox et al.*, 1954; *Bring et al.*, 1955; *Odland & Ostle*, 1956; *Bessey et al.*, 1956; *Donald et al.*, 1963).

The intake of thiamine was very low in both groups compared with the weekly intake of 11.0 mg per person reported by *Pekkarinen* (1962) for the Finnish population during the same seasons of the year. The riboflavin intake also remained below the value reported by *Pekkarinen*, 15.8 mg/week. The fact that the intakes of these nutrients hardly differed at all between the groups, although serum values were different, may suggest disturbed utili-

zation of these vitamins. On the basis of the present study, disorders in thiamine and riboflavin metabolism may be assumed to constitute a diathetic factor for the development of AS.

The serum iron content is generally lower in women than in men. *Heilmeyer & Plötner* (1937) reported a mean value of 89 μg % for women and 126 μg % for men. On a Finnish series *Hirvonen* (1941) reported slightly higher mean values: 119 μg % and 140 μg %, respectively. The lower mean serum iron values in the control subjects than in patients with AS in the present study may have arisen from the fact that 18 of the 32 control subjects were women and only 14 were men, while the AS group had equal numbers of men and women.

Neill (1963) reported from his study that 54 per cent of the patients with AS consumed »relatively high quantities of sticky carbohydrate». The fact that the majority of the patients with AS consumed, according to the criterion of the present study, plenty of refined carbohydrates may have affected the incidence of Candida in the mouth and by this route the presence of AS. Poor dietary habits again may be a result of the search for soft food owing to difficulties in mastication. It should be borne in mind that the present series consisted of persons who had sought treatment to obtain dentures and who therefore had severe masticatory insufficiency, also those who wore earlier dentures. Particularly in these latter subjects a carbohydrate diet could create excellent growing conditions for the oral microflora, especially if they were in the habit of wearing their dentures for lengthy periods, e.g. overnight, without cleaning them. Even according to the present study, the prevalence of AS was higher among the subjects wearing earlier dentures than in the edentulous with no dentures. Whether or not the dentures were kept in the mouth during the night was not checked in the present study.

CONCLUSIONS

On the basis of the present study, the following conclusions can be drawn concerning the prevalence of AS in subjects with decreased occlusal vertical dimension:

1. The prevalence of AS is higher in women than men.
2. The prevalence of AS is lower in women without dentures than in those wearing dentures.
3. The AS seems to be unilateral as often as bilateral.
4. The AS frequently coincides with DSM.
5. Age does not seem to affect the prevalence of AS.

6. The duration of the edentulous period does not seem to affect the prevalence of AS in the edentulous with no dentures.
7. A subclinical deficiency of thiamine and riboflavin may create a predisposition to AS.

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SUMMARY

The material comprised 339 subjects (146 men, 193 women) who wished to have full dentures made. They had either one or both edentulous jaws, and all had decreased occlusal vertical dimension.

The material included 61 patients (18 per cent) with angular stomatitis (AS). The prevalence of AS was higher in women than men ($P<0.05$). Female denture wearers had AS much more frequently ($P<0.0005$) than the women without dentures. The male prevalence of AS did not differ on this point. In women the prevalence of AS was higher in the winter than in the summer ($P<0.05$), while no such difference was noted for men. The completely edentulous were affected with this lesion more often ($P<0.05$) than those with natural teeth in one of the jaws. Age did not affect the prevalence of AS, nor was poor oral hygiene found to have any definite influence.

The prevalence of AS in women wearing dentures was much higher ($P<0.005$) than in the male denture-wearers. The lesion was more frequent ($P<0.025$) in connection with a denture sore mouth than when the denture-bearing mucosa was healthy. The age or type (full upper and lower, or other) of the dentures did not appreciably affect the prevalence of AS. The length of the edentulous period was not found to be correlated with the development of AS.

In patients affected with AS the serum thiamine ($P<0.05$) and free riboflavin ($P<0.02$) values were lower than in those with healthy corners of the mouth. The dietary intake of iron of the patients with AS was lower ($P<0.02$) than that of the other subjects examined.

The lesion had healed in 77 per cent of the AS patients re-examined one year after the new dentures had been fitted. The serum thiamine and free

riboflavin showed an increase ($P<0.02$), while serum folic acid showed a declining trend ($P<0.05$). An increase in niacin intake could be recorded ($P<0.05$).

RÉSUMÉ

PRÉVALENCE DE LA CHÉLITE ANGULAIRE COMMISSURALE
CORRÉLATION AVEC LA COMPOSITION DE L'ALIMENTATION ET LE MÉTABOLISME DES VITAMINES ET DU FER

Le matériel initial de cette étude se composait de 339 sujets (146 hommes et 193 femmes) souhaitant se faire des prothèses complètes. Ils présentaient une édentation soit d'une des mâchoires soit des deux. Tous présentaient une diminution de la dimension verticale de l'occlusion.

Le matériel comprenait 61 patients (18 %) présentant une chélite angulaire commissurale (CA). La prévalence de la CA était plus élevée chez les femmes que chez les hommes ($P<0,05$). Les femmes portant des prothèses présentaient beaucoup plus fréquemment une CA que les femmes sans prothèses ($P<0,0005$). Chez les hommes, il n'existait pas de différence entre les prévalences correspondantes. Chez les femmes, la prévalence de la CA était plus élevée en hiver qu'en été ($P<0,05$), alors qu'il n'existait pas de différence à ce point de vue chez les hommes. Les édentés complets étaient plus souvent atteints ($P<0,05$) que ceux qui avaient des dents naturelles à l'une des deux mâchoires. L'âge restait sans influence sur la prévalence de la CA, et, de même, une hygiène bucco-dentaire déficiente n'a pas semblé avoir d'influence nette.

La prévalence de la CA chez les femmes portant des prothèses était beaucoup plus élevée ($P<0,005$) que chez les hommes porteurs de prothèses. Ces lésions se rencontraient plus souvent ($P<0,025$) chez les patients présentant une stomatite sous plaque prothétique que lorsque la muqueuse de sustentation de la prothèse était saine. L'âge des prothèses et leur type (complet du haut et du bas, ou autre type) n'avaient pas d'influence notable sur la prévalence de la CA. La durée de l'édentation ne présentait pas de corrélation avec l'apparition de la CA.

Chez les patients présentant une CA, les taux de thiamine ($P<0,05$) et de riboflavine libre ($P<0,02$) du sérum étaient plus bas que chez les sujets dont les commissures étaient saines. L'ingestion alimentaire de fer des patients ayant une CA était plus basse ($P<0,02$) que celle des autres sujets examinés.

Chez 77 % des patients présentant une CA qui ont été réexaminés un an après la confection des nouvelles prothèses, les lésions étaient guéries. Les taux de thiamine et de riboflavine libre dans le sérum présentaient une aug-

mentation ($P < 0{,}02$), tandis que le taux d'acide folique dans le sérum tendait à baisser ($P < 0{,}05$). Une augmentation de l'absorption de niacine pouvait être constatée ($P < 0{,}05$).

ZUSAMMENFASSUNG

FREQUENZ DER ANGULÄRSTOMATIT. KORRELATION MIT DER NAHRUNGSZUSAMMENSETZUNG UND DEM VITAMIN- UND EISENSTOFFWECHSEL

Das Material umfasst 339 Menschen (146 Männer, 193 Frauen), die im Bedarf einer prothetischen Behandlung waren. Sie hatten einen oder beide Kiefer ohne Zähne, und alle hatten eine vermindert vertikale Okklusionsdimension.

Das gesamte Material umfasste 61 Patienten mit Angulärstomatit (AS) (=18 %). Bei den Frauen kam AS häufiger vor als bei den Männern ($P < 0{,}05$). Frauen mit Prothese hatten AS weitaus häufiger ($P < 0{,}0005$) als Frauen ohne Prothese. Die AS-Frequenz bei Männern wies in dieser Hinsicht keinen Unterschied auf. Bei Frauen kam AS im Winter häufiger vor als im Sommer ($P < 0{,}05$); bei Männern konnte dieser Unterschied nicht beobachtet werden. Völlig Zahnlose litten an der Läsion öfter ($P < 0{,}05$) als Patienten mit eigenen Zähnen in einem Kiefer. Das Alter spielte bei dem Auftreten der AS keine Rolle. Auch konnte einer schlecten Hygiene des Mundes keine eindeutige Einwirkung zugeschrieben werden.

Frauen mit Prothese hatten AS viel häufiger ($P < 0{,}005$) als Männer mit Prothese. Bei Stomatitis prothetica kam die Läsion häufiger vor ($P < 0{,}025$), als bei gesunder Prothesenunterlage. Weder Alter noch Typus der Prothese (volle obere und untere oder anderer Art) hatten für das Auftreten der AS eine nennenswerte Bedeutung. Ein Zusammenhang zwischen der Dauer der Zahnlosigkeit und dem Eintreten der AS konnte nicht beobachtet werden.

Bei Patienten mit AS waren die Werte des Thiamins ($P < 0{,}05$) und des freien Riboflavins ($P < 0{,}02$) im Serum niedriger als bei Patienten mit gesunden Mundwinkeln. Die diätetische Aufnahme von Eisen war bei AS-Patienten geringer ($P < 0{,}02$) als bei anderen Untersuchten.

Ein Jahr nach dem Einsetzen von neuen Prothesen war die Läsion bei 77 % der untersuchten AS-Patienten geheilt. Es wurde eine Erhöhung des Thiamins und des freien Riboflavins ($P < 0{,}02$), demgegenüber aber ein Sinken der Folsäure im Serum ($P < 0{,}05$) festgestellt. In der Aufnahme von Nicotinsäure konnte eine Zunahme ($P < 0{,}05$) festgestellt werden.

An Hand der Untersuchung wurden die nachstehenden Schlussfolgerungen gezogen: 1. AS kommt bei Frauen häufiger vor als bei Männern. 2. AS ist

bei Frauen ohne Prothese seltener als bei Frauen mit Prothese. 3. AS scheint ebenso häufig monolateral als bilateral aufzutreten. 4. AS erscheint häufig parallel mit Stomatitis prothetica. 5. Das Alter scheint für das Auftreten der AS keine Bedeutung zu haben. 6. Die Dauer der Zahnlosigkeit scheint für die AS-Frequenz bei Zahnlosen ohne Prothese keine Bedeutung zu haben. 7. Ein subklinischer Thiamin- und Riboflavinmangel kann den Patienten für AS prädisponieren.

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