10

The Systemic Influences

Introduction

A significant number of patients with mechanically satisfactory dentures are unable to tolerate them; on the other hand, some patients carry on for years, or even a lifetime, with technically poor appliances. It therefore appears that prosthodontic success or failure cannot be the result *exclusively* of the mechanical fit of the prosthesis.

The major emphasis in most standard prosthodontic books is on *denture design* and *oral anatomy*. The obvious and desirable intent is to produce a denture that will fit the tissues as closely as possible. This chapter will consider the other aspect of the problem—how the tissues can best be made to accept the denture.

In order to consider intelligently the role of systemic factors and denture tolerance, it is first necessary to outline the relationship of known nonoral factors and denture success or failure.

The Arithmetic of Prosthodontic Success

Much of present-day prosthodontic thinking can be expressed in an equation which stipulates that a good, technically made appliance should yield success, as shown in the equation in Fig. 10-1.

This formula would indeed represent basic prosthodontic principle if it were not true that some persons are unable to function with a denture which seems to meet all mechanical specifications (Fig. 10-1). Thus, it appears from Fig. 10-1 (since things equal to the same thing are equal to each other) that denture design is not the only variable that makes for success or failure.

What else, then, must be considered? This question leads inevitably to the subject of the genesis of disease as expressed by clinical symptoms and signs. This topic has been discussed by many investigators and has been recently reviewed (Cheraskin, 1959).

properly fitting appliance	+	suitable oral anatomy	=	successful denture wear
a	+	b	=	c
properly fitting appliance	+	suitable oral anatomy	=	unsuccessful denture wear
a	+	b	=	d
successful denture wear		=		unsuccessful denture wear
c		=		d

Fig. 10-1.

(#1)	healthy body (good tissue tolerance)	x	no oral trauma (well-fitting denture)	=	no oral symptoms and signs (successful denture)
(#2)	healthy body (good tissue tolerance)	x	oral trauma (poor-fitting denture)	=	oral symptoms and signs (unsuccessful denture)
(#3)	unhealthy body (poor tissue tolerance)	x	oral trauma (poor-fitting denture)	=	oral symptoms and signs (unsuccessful denture)
(#4)	unhealthy body (poor tissue tolerance)	x	no oral trauma (well-fitting denture)	=	oral symptoms and signs (unsuccessful denture)

Fig. 10-2.

It appears that denture tolerance, as measured by oral symptoms and signs (and this is the only way it can be measured), requires a healthy body *and* a mechanically adequate appliance. The relationships that yield success or failure are pictured in Fig. 10-2.

The first equation represents the ideal situation. It is exemplified by the young man who, perhaps through accident, has lost his teeth. He is still relatively healthy. The insertion of a well-fitting denture yields (as shown in Eq. 1) no oral symptoms or signs. This is obviously the most desirable situation for success. It is also clear that, even in a healthy person, an *obviously* poor mechanical appliance may be doomed to failure. This situation, as pictured in the second equation, yields oral symptoms and signs. The next possibility (as shown in Eq. 3) is also relatively clear-cut: a poor-fitting denture is inserted upon unhealthy tissue. There is every reason to believe that the denture will prove unsuccessful. The fourth and last equation demonstrates the most interesting possibility: the denture is mechanically satisfactory, but the patient still cannot tolerate it. Here, there is every indication to seek one or more systemic factors that are contributing to poor tissue tolerance. The problem, actually, can be expressed more correctly in equation form (Fig. 10-3).

It is conceivable, at least theoretically, that a patient could have, for example, perfect carbohydrate, protein, fat, vitamin, and mineral metabolism. It is also hypothetically possible for centric relation, occlusion, vertical dimension, denture size, etc., to be perfect. With all these factors equal to zero, the end product (on the right side of the equation) would also be zero, signifying no oral symptoms and/or signs. The theoretic man just pictured is shown in Fig. 10-4.

Usually, however, some or all of the factors just mentioned are operative. The value on the right side of the equation is then great, there

systemic factors	x	local factors	=	success or failure
(a+b+c+d+e.....)		(p+q+r+s+t+u+v+w..)		of the denture

a = carbohydrate metabolism	p = centric relation
b = protein metabolism	q = occlusion and arrangement
c = fat metabolism	r = vertical dimension
d = vitamin metabolism	s = denture size
e = mineral metabolism	t = allergic agents
	u = ridge anatomy
	v = tongue activity
	w = polished surfaces

Fig. 10-3.

systemic factors		local factors		success or failure of the denture
carbohydrate metabolism	= 0	centric relation	= 0	
protein metabolism	= 0	occlusion and	= 0	
fat metabolism	= 0	arrangement	= 0	= 0
vitamin metabolism	= 0	vertical dimension	= 0	no symptoms and signs
mineral metabolism	= 0	denture size	= 0	successful denture wear
		allergic agents	= 0	
		polished surfaces	= 0	

Fig. 10-4.

are many and serious symptoms and signs, and the denture is unsuccessful, as depicted in Fig. 10-5. Three interesting features of this question require elaboration.

1. A number of factors are operating in concert.

2. No one of the factors in itself is significant. However, when added and multiplied, the end result is many symptoms and signs. The resultant of these singly minimal problems is an unsuccessful appliance. Thus, as shown in this last equation, centric relation, occlusion, and vertical dimension may all be near perfect (shown by values of 2 each). However, when added, the local factors make for a significant problem (the value 10). Then, when this value is multiplied by the minimal but collectively important systemic factors, the end result is considerable.

3. Correction of any one or a combination of factors will lower the end result on the right side of the equation. For example, if centric relation, occlusion, vertical dimension, denture size, and tongue activity are adjusted (e.g., each value reduced from 2 to 1), then the sum of the local factors is diminished from 10 to 5. Thus, as shown in Fig. 10-6, without any systemic correction, there will be fewer symptoms and signs. On the other hand, it is possible to arrive at the same end result (on the right side of the equation) by altering some or all of the systemic factors and doing nothing about the local irritants. This is shown in Fig. 10-7.

Obviously, the most desirable result is attained by eliminating all deleterious influences, so that the number on the right diminishes much more, indicating even fewer symptoms and signs and an even greater degree of prosthodontic success (Fig. 10-8).

Effects of Systemic Factors upon the Oral Cavity

Systemic Problems and Tooth Loss

Before considering systemic influences upon denture success, it is first necessary to review briefly the known relationships between sys-

systemic factors (a+b+c+d+e.....)			local factors (p+q+r+s+t..)		success or failure of the denture
carbohydrate metabolism	= 2		centric relation	= 2	
protein metabolism	= 2		occlusion and		
fat metabolism	= 2		arrangement	= 2	
vitamin metabolism	= 2		vertical dimension	= 2	
mineral metabolism	= 2		denture size	= 2	
			ridge anatomy	= 2	
	10	x		10 = 100	(many symptoms and signs) unsuccessful denture

Fig. 10-5.

systemic factors (a+b+c+d+e)		x	local factors (p+q+r+s+t)		=	success or failure of the denture
carbohydrate metabolism	= 2		centric relation	= 1		
protein metabolism	= 2		occlusion	= 1		
fat metabolism	= 2		vertical dimension	= 1		
mineral metabolism	= 2		denture size	= 1		
vitamin metabolism	= 2		ridge anatomy	= 1		
	10	x		5	=	50 fewer symptoms and signs

Fig. 10-6.

temic disturbances and tooth loss. This is most important since the problem which leads to denture failure may well be the very same problem which originally caused the loss of teeth and the need for a prosthetic appliance.

The two major problems which lead *directly* to tooth loss are dental caries and the periodontal diseases (Brekhus, 1929; Allen, 1944). However, reports in the literature suggest that a host of systemic factors may be operating in the development of caries and the periodontal pathoses. For example, tooth loss parallels glucose imbalance (Cheraskin and Moller, 1960; Moller and Cheraskin, 1960). There is exciting evidence of a definite relationship between alveolar bone loss and negative nitrogen balance (Person, 1959). Less definite, but presumptive, findings pointing to systemic factors in tooth loss are available in the literature (Seidler, Miller, and Wolf, 1950; Sandler and Stahl, 1954, 1960; Karshan, 1952; Orban, 1948).

Systemic Problems and Denture Tolerance

This section will give first a brief review of the literature on systemic factors in denture success. Secondly a summary will be given of work presently being performed in the Section on Oral Medicine at the University of Alabama School of Dentistry in Birmingham, Ala.

There is a cliché in the prosthodontic literature that a physical examination is indicated in denture patients (Niiranen, 1954; Reither, 1959). However, no mention is made of the specific problems that are encountered. In fact, no well-controlled study or satisfactory analysis has been made of the medical status of denture patients.

A number of reports simply indicate that the denture patient requires special dietary consideration (Academy of Denture Prosthetics, 1959). However, the information is very general and no specific recommendations are offered. Other publications deal with specific nutrients; e.g., the recommendation is made that the denture patient needs a high-protein regime (Jamieson, 1958; Silverman, 1958; Collett, 1958; Kimball, 1954). However, precisely how much protein should be recommended and how one determines who needs it are not discussed. Several publications recommend

systemic factors (a+b+c+d+e)		x	local factors (p+q+r+s+t)		=	success or failure of the denture
carbohydrate metabolism	= 1		centric relation	= 2		
protein metabolism	= 1		occlusion	= 2		
fat metabolism	= 1		vertical dimension	= 2		
vitamin metabolism	= 1		denture size	= 2		
mineral metabolism	= 1		ridge anatomy	= 2		
	5	x		10	=	50 fewer symptoms and signs

Fig. 10-7.

systemic factors (a+b+c+d+e)	x	local factors (p+q+r+s+t)	=	success or failure of the denture
carbohydrate metabolism	= 1	centric relation	= 1	
protein metabolism	= 1	occlusion	= 1	
fat metabolism	= 1	vertical dimension	= 1	
vitamin metabolism	= 1	denture size	= 1	
mineral metabolism	= 1	ridge anatomy	= 1	
	5	x		5 = 25 even fewer symptoms and signs

Fig. 10-8.

multivitamin supplementation (Silverman, 1958; Kimball, 1954; Cahn, 1941; Bartels, 1944; Pliess and Bornemann, 1958). Once again, no specific information is given as to how much should be prescribed and how one establishes the candidate for such therapy. Several reports list specific vitamins that should be prescribed for denture patients; e.g., vitamin A (Schweiger, 1959) is suggested to maintain epithelial integrity. Vitamin B complex is probably prescribed by more clinicians than any other preparation (Bremer, 1948; Jamieson, 1958; Boos, 1959; Schweiger, 1959; Sharp, 1960). Some authorities prefer specific vitamin B fractions, such as pantothenic acid (Reither, 1958). A few clinical reports suggest the use of vitamin C supplementation (Jamieson, 1958; Boos, 1959; Schweiger, 1959; Frahm, 1943). No reference is made in any of these papers as to a rational dose or mode of evaluation of the ascorbic acid needs of the patient. Frequent mention is made of the need for hormones, particularly for estrogens during the female climacteric (Schweiger, 1959; Kimball, 1954; Cahn, 1941; Frahm, 1943; Bartels, 1944; Pliess and Bornemann, 1958). Brief reference is made to minerals (Jamieson, 1958), especially calcium (Schweiger, 1959; Frahm, 1943). Iron deficiency has also been indicted as a cause of denture sore mouth (Darby, 1946; Langer, 1949; Brunel, 1948; Nyquist, 1952).

The major difficulty with all these suggestions is that the conclusions are derived only from cursory clinical observation of a few cases.

It should be evident from the previous review that much information is still necessary to determine the role of systemic factors in tissue tolerance. Accordingly, a pilot study was carried out in the Section on Oral Medicine at the University of Alabama School of Dentistry in Birmingham, Ala. The findings of that series will be presented here, since they represent a carefully controlled experimental situation regarding the problem of tissue tolerance and systemic factors.

It should be recalled that a number of systemic factors may operate to reduce tissue tolerance. Some of these factors have been investigated; they include metabolism of (1) carbohydrate, (2) protein, (3) vitamins, (4) minerals, and (5) electrolytes.

CARBOHYDRATE METABOLISM. Carbohydrate metabolism and tissue tolerance were studied in 19 patients withing the age range of 50 to 69 years. In this group were 8 patients with 25 to 30 teeth, who will be referred to as the *dentulous* group. Included also were 7 *edentulous* patients who tolerated their dentures very well and 4 *edentulous* patients who complained of sore spots.

Figure 10-9 shows the cortisone-glucose tolerance patterns of the 50- to 69-year-old patients with 25 to 30 teeth and the edentulous subjects with and without denture difficulties. It is abundantly clear from Fig. 10-9 that the blood glucose levels at every temporal point during the cortisone-glucose tolerance test were lowest in the dentulous patients. The mean glucose levels are slightly higher in the edentulous patients without denture difficulties. Finally, at every point in the pattern, the blood glucose levels are highest in the edentulous subjects with denture difficulties.

This type of evidence suggests some relationship between carbohydrate metabolism and dentulousness or edentulousness. Further, this chart provides presumptive evidence that there is some relationship between denture tolerance and carbohydrate metabolism.

More convincing evidence for the relationship between carbohydrate metabolism and tissue tolerance to dentures can be derived from the examination of individual patients. Therefore, one such case report is included here which demonstrates a possible cause-and-effect relationship between sugar metabolism and the ability of tissues to withstand prosthodontic trauma.

A 42-year-old white man was admitted to the Section on Oral Medicine at the University Medical Center in Birmingham, Ala., for study. The patient had been edentulous for less than 1 year. During that short period, he had had two complete sets of dentures made. The only significant findings included weight loss during the past 6 months, occasional gingival tenderness, slight loss of the papillae at the tip of the tongue, minimal marginal lingual indentations suggesting slight macroglossia, and minimal fissures on the dorsum of the tongue.

At the initial examination on Feb. 19, 1960, the cortisone-glucose tolerance test was performed. Figure 10-10 shows a fasting blood glucose of 80 mg per cent with no sugar or acetone in the urine. Thirty minutes after the ingestion of 100 Gm glucose, the blood glucose rose to 160 mg per

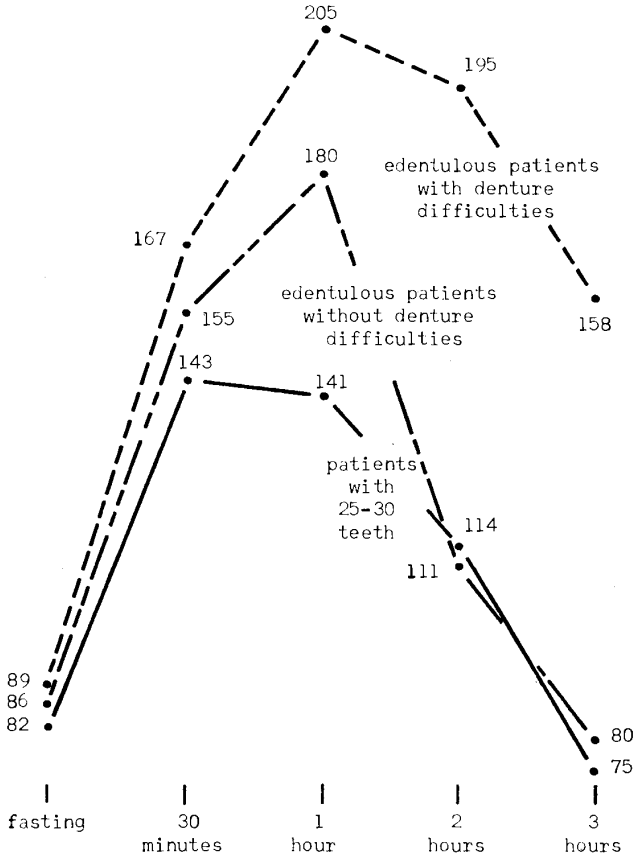

Fig. 10-9. Cortisone-glucose-tolerance patterns of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (mean blood glucose in milligrams per cent).

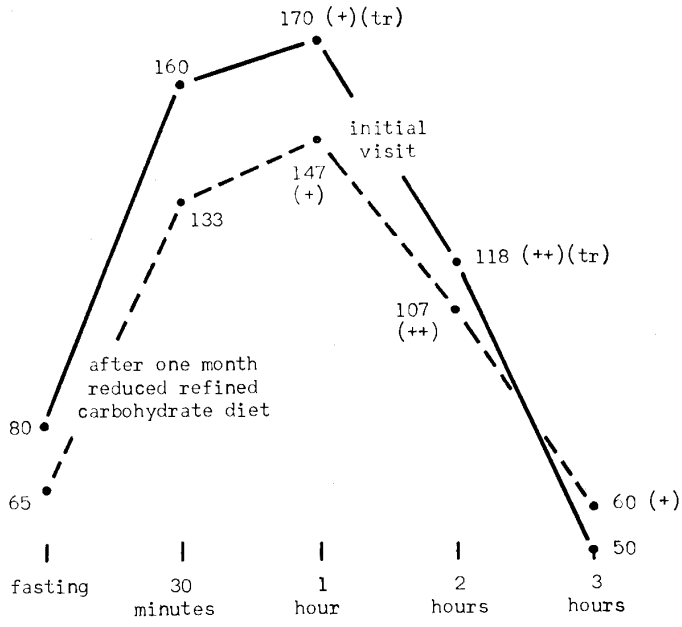

Fig. 10-10. Cortisone-glucose-tolerance patterns initially and after 1 month on a reduced-refined-carbohydrate diet (mean blood glucose in milligrams per cent).

cent, with still no evidence of sugar or acetone in the urine. One hour after the fasting determination the glucose had climbed to 170 mg per cent with 1+ glycosuria and a trace of acetone. At the 2-hour point, the blood glucose level had declined to 118 mg per cent with 2+ sugar and a slight trace of acetone. Finally, at the 3-hour determination, the glucose was 50 mg per cent without glycosuria or acetonuria. According to most authorities, this glucose tolerance pattern would not be regarded as indicating diabetes mellitus. In fact, according to most standards, it would not even be considered as suggestive of decreased glucose tolerance.

The patient was instructed to maintain a reduced refined carbohydrate diet for about 1 month. He returned Mar. 25, 1960, to report that he no longer suffered with gingival tenderness. However, an examination disclosed that the tongue findings previously reported were still present. Figure 10-10 shows the cortisone-glucose tolerance pattern derived at the second visit following a 1-month regime of reduced carbohydrate intake. At almost every point the blood glucose levels were lower than initially. In addition, there was the striking absence on the second visit of acetone in the urine.

From observations of this type one cannot conclude that a reduction in blood glucose *causes* improvement in tissue tolerance. However, it seems safe to say that glucose level reflects biochemical change that parallels clinical alterations. It is possible that the problem in the person described above may have been nutritional. On the other hand, there is also the likelihood that it may have been hormonal.

Protein Metabolism. It was mentioned earlier in the review of the literature that protein is believed to be intimately associated with tissue tolerance. However, as pointed out, no stomatologic studies have been performed under carefully controlled conditions.

The 19 patients within the age range of 50 to 69 years were studied with regard to total serum protein and tissue tolerance. As in the study of carbohydrate metabolism, 8 patients had 25 to 30 teeth, 7 were edentulous and tolerated their dentures well, and 4 were edentulous and complained of sore spots.

Figure 10-11 shows that the mean serum

protein level for the dentulous group was 7.02 Gm per cent. The protein level for the asymptomatic edentulous patients proved to be 7.47 mg per cent. Of particular interest is the relative hypoproteinemia of the edentulous symptomatic group, as shown by a mean total serum protein level of 6.25 Gm per cent.

It is important to emphasize that such data do not prove that hypoproteinemia *causes* denture intolerance. However, the evidence is presumptive and supports those who tend to favor the use of relatively high protein intake in patients with denture difficulties.

VITAMIN METABOLISM. Frequent mention is made in the literature that vitamins are helpful in improving tissue tolerance. As mentioned above, however, this belief has not been subjected to controlled study.

In the main, the value of laboratory testing for mild vitamin deficiency states is open to considerable debate. Consequently, it is difficult to determine the incidence and prevalence of such conditions.

The intradermal ascorbic acid decolorization test time was studied in the 19 patients in the 50- to 69-year age group with teeth and without teeth, both symptomatic and asymptomatic with regard to denture wear. It can be observed from Fig. 10-12 that the mean intradermal time for the dentulous group is 22.0 minutes. The intradermal time for the asymptomatic denture patients is 25.8 minutes; for the patients with denture problems it is 23.7 minutes. Thus, it appears that denture wearers have longer intradermal times and, therefore, poorer ascorbic acid status than patients with teeth.

There is the strong possibility that patients with one vitamin deficiency have others, all delicately interrelated. For example, in the Alabama study a group of patients receiving thiamine chloride showed a significant decrease in intradermal ascorbic acid test time, from 31.7 to 28.1 minutes.

MINERAL METABOLISM. As mentioned earlier, a number of investigators recommend minerals (Jamieson, 1958), particularly calcium (Schweiger, 1959; Frahn, 1943), to patients with prosthetic appliances, but again the recommendation is not based on careful experimental studies.

The 19 patients within the age range of 50 to 69 years were studied with regard to calcium and phosphorus metabolism and tissue

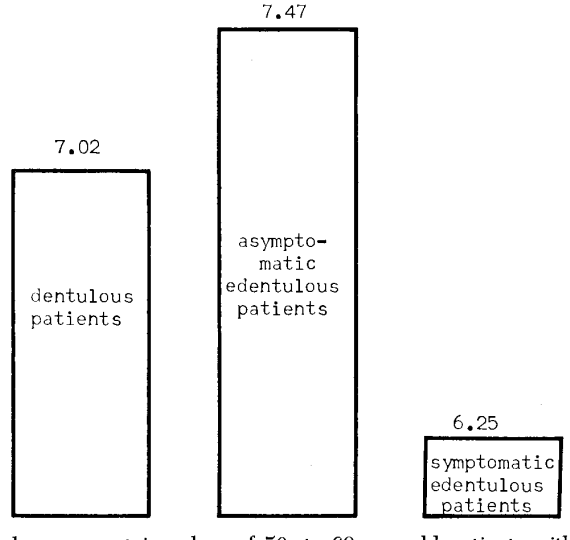

Fig. 10-11. Mean total serum protein values of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (values in grams per cent).

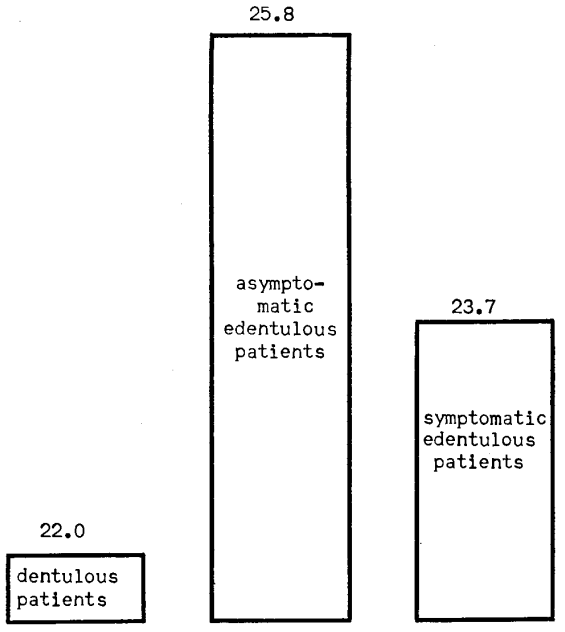

Fig. 10-12. Mean intradermal ascorbic acid decolorization test time of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (test time in minutes).

tolerance. Figure 10-13 shows that the patients with teeth had the highest mean serum calcium levels (10.57 mg per cent). Also shown is the slightly lower mean value (10.47 mg per cent) for the asymptomatic edentulous patients. Finally, one can observe a mean value of 9.90 mg per cent for those edentulous patients who had difficulty in tolerating their dentures.

Once again it is necessary to underscore that such data do not prove that hypocalcemia *causes* denture intolerance. However, the evidence tends to support those investigators who attach significance to calcium levels in denture patients.

More convincing evidence for the relationship between calcium metabolism and denture tolerance can be derived from an examination of individual patients. Therefore, a case report is included here that demonstrates the cause-and-effect relationship between calcium metabolism and the ability of tissues to withstand the trauma of a prosthetic appliance.

A 77-year-old white woman was admitted to the Section on Oral Medicine at the University Medical Center in Birmingham, Ala., by her private physician with a diagnosis of generalized leukoplakia. The patient said that she had visited two physicians and one dentist for the present problem. She had been without teeth for over a decade, during which time only full upper and lower dentures had been made. The only significant findings included easy bruisability and occasional gingival tenderness.

At the initial examination on Apr. 14, 1960, the serum calcium level proved to be 9.8 mg per cent. Figure 10-13 shows the initial serum calcium finding in this patient compared with the mean level of the entire group of symptomatic edentulous individuals. The similarity between the findings is clear-cut.

The patient was instructed to maintain a reduced refined carbohydrate diet for 1 month. She returned May 25, 1960, and reported that she no longer suffered with gingival tenderness. In addition, she added that she had observed a decrease in fluid intake during the past month. Figure 10-13 shows that, at this second visit, the serum calcium level had risen to 10.20 mg per cent. Once again, this illustration shows the similarity

of the serum calcium level of this person to that of the group of asymptomatic edentulous patients.

From observations of this type, one cannot conclude that an increase in serum calcium *causes* improvement in tissue tolerance. However, as with glucose, it seems safe to say that the calcium level reflects biochemical change which parallels clinical alterations. The problem in this patient may be nutritional or, since no calcium was added to the diet, it may be hormonal.

Figure 10-14 pictorially describes the serum phosphorus levels for the three groups of individuals and the specific findings in the 77-year-old woman in the preceding case history. Once again it is clear that the symptomatic edentulous patients have lower serum phosphorus levels than those with teeth and those with asymptomatic dentures.

Finally, Fig. 10-15 outlines the calcium-phosphorus product. A number of investigators contend that the most reliable measure of calcium and phosphorus metabolism may be obtained by multiplying the calcium and phosphorus values. It is generally agreed that the product should be close to 40. Figure 10-15 shows that the value closest to 40 is obtained in the dentulous patients. However, the asymptomatic edentulous subjects show a mean calcium-phosphorus product very close to the so-called physiologic norm. Figure 10-15 shows clearly the much lower calcium-phosphorus product in the symptomatic edentulous group. Also, one may observe the decided increase in the calcium-phosphorus product in the 77-year-old woman of the case history; it is clear that this increase paralleled the disappearance of gingival tenderness.

ELECTROLYTE METABOLISM. Mention has been made earlier of the need for gross dietary changes, including increased intake of vitamins and minerals. As far as can be determined, there is no mention in the literature of alterations in electrolytes and their possible correlation with low tissue tolerance to dentures.

Sodium and potassium levels in the serum were studied in the 19 patients within the age range of 50 to 69 years. Figure 10-16 shows a mean serum sodium level of 139.1 mEq per liter in the patients with teeth; a slightly higher mean serum sodium level (139.5 mEq per liter) in the edentulous group without symptoms; and a much reduced mean serum sodium level (137.3 mEq per liter) in the symptomatic edentulous patients.

Again, such data do not prove that electrolyte imbalance *causes* denture intolerance, but

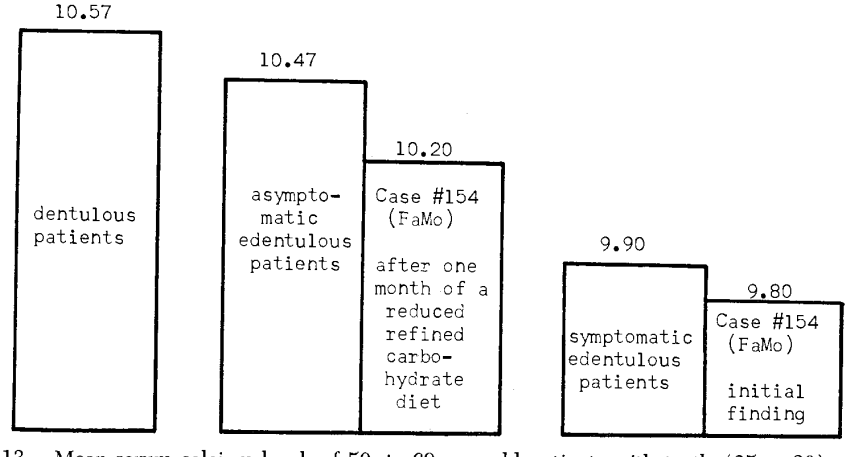

Fig. 10-13. Mean serum calcium levels of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (values in milligrams per cent).

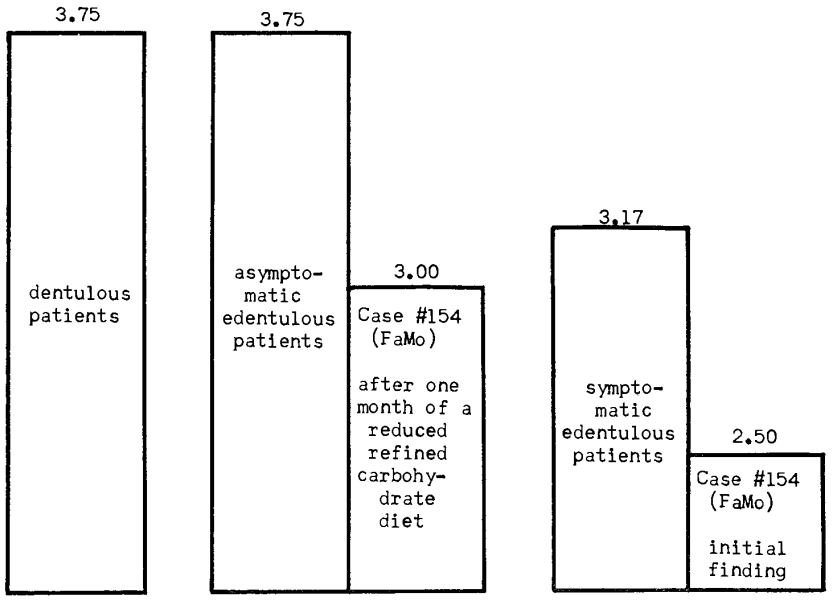

Fig. 10-14. Mean serum phosphorus levels of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (values in milligrams per cent).

they tend to support those investigators who favor the correction of electrolyte levels in persons who have denture difficulties.

Figure 10-17 depicts the mean serum potassium levels of the same group of patients. The chart shows graphically the lowest mean serum potassium levels (4.43 mEq per liter) in the dentulous group, a higher mean value (4.57 mEq per liter) in the asymptomatic edentulous patients, and an even higher level (4.65 mEq per liter) in the edentulous group with symptoms.

More convincing evidence for the relationship between electrolyte metabolism and denture tolerance can be derived from an examination of individual patients. Therefore, a case report is included here that demonstrates the correlation between serum sodium and serum potassium and the ability of tissues to withstand the trauma of a prosthetic appliance.

A 61-year-old white man, a carpenter, was referred to the Section on Oral Medicine from the Department of Dermatology because of persistent lingual ulcers that had not responded to therapy. The patient had been examined by a number of dermatologists.

Apparently, pleomorphic ulcers had been present on the dorsum of the tongue for approximately 7 months, during which time they had remained the same size. In addition, the patient reported a swelling of the tongue after minimal traumatization with rough foods. As far as he could determine, the swelling had begun approximately 3 to 4 months prior to the initial examination. There was no history of ulcers elsewhere on the body. The ulcers did not bleed but periodically burned.

The past history and family history were all negative. The patient had recently had a physical examination with chest roentgenograms and had been reported in good health.

At the time of the examination he had been taking adrenocortical hormones and also multivitamin tablets.

The findings in the oral cavity were not remarkable except for deep and large ulcers on the tongue. The patient had been wearing an upper prosthetic appliance for approximately 20 years. The lower teeth had been extracted because they were thought to be irritating the ulcers. The tongue had erythematous and pleomorphic ulcers on the lateral surfaces and on the dorsal aspect of the posterior third. There was considerable coating over the entire tongue, with swelling and

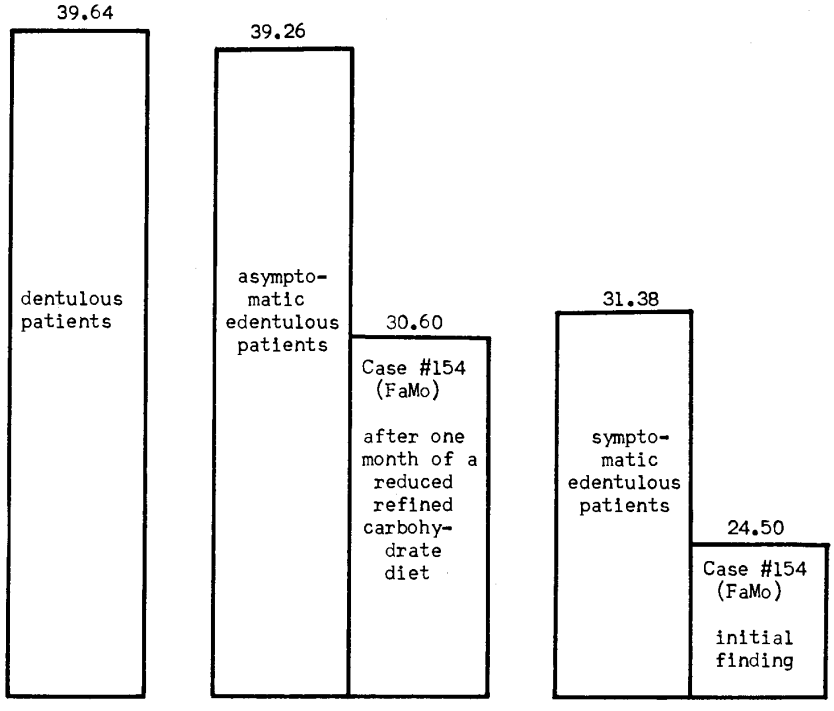

Fig. 10-15. Mean calcium-phosphorus product of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties.

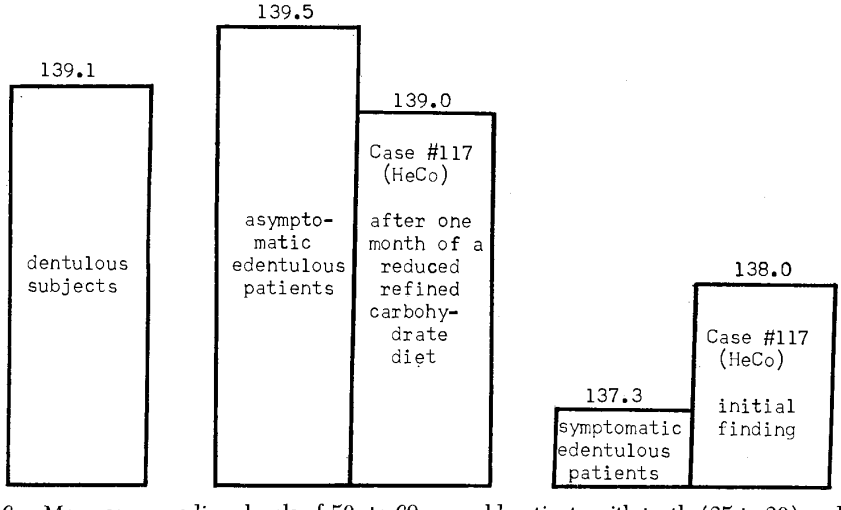

Fig. 10-16. Mean serum sodium levels of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (values in milliequivalents per liter).

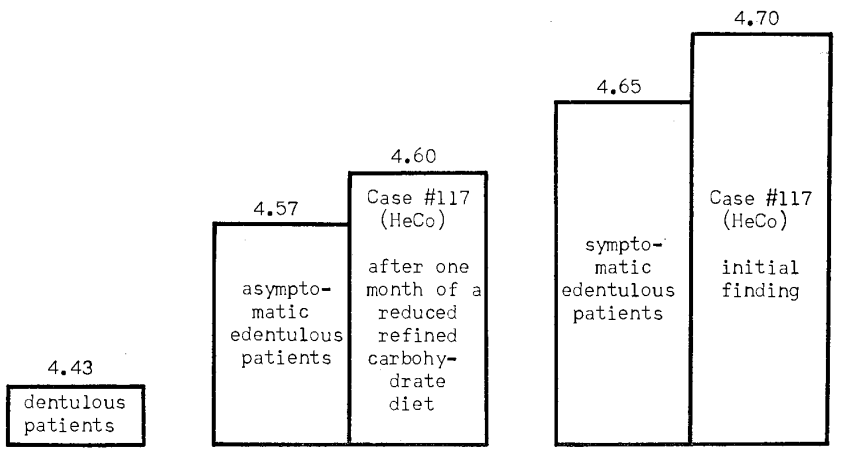

Fig. 10-17. Mean serum potassium levels of 50- to 69-year-old patients with teeth (25 to 30) and edentulous with and without denture difficulties (values in milliequivalents per liter).

fissuring and areas of smoothness indicating the absence of papillae. In addition, the lips showed angular cheilosis.

On Mar. 9, 1960, the patient was instructed to decrease the adrenal steroid medications. In addition, he was placed on a diet free of refined sugars and white flour and high in protein. He returned approximately 1 week later (Mar. 16, 1960) reporting that he had had burning of the tongue for several days, and increased swelling. He also reported that the ulcer on the left side of the tongue was worse; this was confirmed by clinical examination. The tongue appeared larger than 1 week previously, and the ulcers on the dorsum and the left lateral aspect were slightly larger and more erythematous. The patient was asked to remain on the sugar-free diet and to return to the steroid therapy.

On Mar. 23, 1960, the patient reported by telephone that he was not improved. Accordingly, multiple vitamins and minerals were added to the diet.

On Apr. 8, 1960, the patient said that the tongue was slightly improved. He was instructed to remain on the diet, to continue the vitamin and mineral supplementation, and to discontinue the steroid regime.

An examination approximately 10 days later (Apr. 18, 1960) showed that the ulcer on the right side of the tongue was much improved, though the others remained the same. On Apr. 20, 1960, four units of insulin were recommended daily, and on Apr. 27, 1960, the therapy was changed to four units of insulin twice daily.

An examination on Apr. 29 showed continued improvement of the tongue ulcers, and on May 4, 1960, the insulin was reduced to four units per day. At that time, it was noted that the ulcers on the side of the tongue were healing but on the dorsum the tongue appeared unchanged.

Subsequent examinations on May 11, 1960, and May 13, 1960, showed that all ulcers were improving and that the tongue was covered with papillae. Of particular interest was the increase in serum sodium and the decrease in serum potassium with dietary correction (Figs. 10-16 and 10-17).

Summary

Some of the relationships between *systemic* factors and denture tolerance have been discussed. It is clear that denture success and failure are not exclusively the result of *denture design* and *oral anatomy*.

A review of the literature indicates an awareness of systemic influences and denture tolerance. However, the level of consciousness of the relationship is low. Accordingly, the recommendations are vague.

An attempt has been made to demonstrate biochemical patterns in elderly subjects with a full complement of teeth, with full dentures which are asymptomatic, and in symptomatic patients with full prosthesis. From these limited observations, it appears that clinical im-

provement parallels biochemical correction. This concept has been developed with regard to the use of a low-refined-carbohydrate high-protein diet. Obviously, this is not the entire story. A broader concept of host resistance and denture tolerance will come only with more information from additional carbohydrate, protein, vitamin, mineral, and hormone studies.

References

The Academy of Denture Prosthetics, 1959, Principles, concepts and practices in prosthodontics: A progress report, *J. Pros. Dent.*, **9**: 528–538.

Allen, E. F., 1944, Statistical study of the primary causes of extractions, *J. Dent. Res.*, **23**: 453–458.

Bartels, H. A., 1944, Bacterial activity and tissue tolerance: Their role in prosthodontia, *J. Dent. Educ.*, **9**: 57–63, discussion, 63–72.

Boos, R. H., 1959, Preparation and conditioning of patients for prosthetic treatment, *J. Pros. Dent.*, **9**: 4–10.

Brekhus, P. J., 1929, Dental disease and its relation to the loss of human teeth, *J.A.D.A.*, **16**: 2237–2247.

Bremer, G., 1948, Om remis till sjukhus och lakare, *Skand. Tand. For. Tidsk.*, **40**: 307.

Brunel, M., 1948, "Les manifestations buccales d'intolérance aux résines hethacryliques," thesis, University of Paris.

Cahn, L. R., 1941, The denture sore mouth, *J. Dent. Educ.*, **6**: 141–151.

Cheraskin, E., 1959, The arithmetic of disease, *J. Dent. Med.*, **14**: 71–82.

——— and P. Moller, 1960, The normal glucose tolerance pattern: The development of blood glucose normality by an analysis of oral signs (dental findings), *J. West. Soc. Periodont.*, **8**: 81–94.

Collett, H. A., 1958, Oral conditions associated with dentures, *J. Pros. Dent.*, **8**: 591–599.

Darby, W. J., 1946, The oral manifestations of iron deficiency, *J.A.M.A.*, **130**: 830–835.

Davies, G. N., and J. P. Walsh, 1953, Survey of denture wearers in New Zealand, *New Zealand Dent. J.*, **49**: 124–133.

Frahm, F. W., 1943, Report on ridge atrophy or resorption, *Dent. Items of Interest*, **65**: 165–177.

Jamieson, C. H., 1958, Geriatrics and the denture patient, *J. Pros. Dent.*, **8**: 8–13.

Karshan, M., 1952, The systemic factors in periodontal disease, *J.A.D.A.*, **44**: 656–662.

Kimball, H. D., 1954, Factors to be considered in the control and elimination of soreness beneath dentures, *J. Pros. Dent.*, **4**: 298–311.

Langer, H., 1949, Die Bedeutung des Schleimhautbefundes bei Prothetischen Arbeiten, *Ztschr. Stomatol.*, **46**: 70–77.

Moller, P., and E. Cheraskin, 1960, The relationship of fasting blood glucose to oral signs (dental findings), *Odont. Revy*, 11: 255–270.

——— and ———, 1961, The relationship of two-hour blood glucose to oral signs (dental findings), *New York J. Dent.*, **31**: 5–14.

——— and ———, 1961, The relationship of three-hour blood glucose to oral signs (dental findings), in press.

Niiranen, J. V., 1954, Diagnosis of complete dentures, *J. Pros. Dent.*, **4**: 726–738.

Nyquist, G., 1952, A study of denture sore mouth, *Acta odont. scandinav.*, **10**: 1–154.

Orban, B., 1948, Symposium on systemic aspects of periodontal disease, *J. Periodont.*, **19**: 123–125.

Person, P., 1959, Metabolic studies of human alveolar bone disease: I. Nitrogen, calcium and phosphorus balances, *Oral Surg.*, **12**: 610–635.

Pliess, G., and G. Bornemann, 1958, Oral lesions and atypical growth of epithelial tissue in patients wearing dentures, *Dent. Abstr.*, **3**: 215–216.

Reither, W., 1958, Pathothenic acid medication in inflammation of the oral mucosa beneath removable dentures, *Dent. Abstr.*, **3**: 286.

———, 1959, "Denture stomatitis" a dental as well as a medical problem, *Dent. Abstr.*, **4**: 10–11.

Sandler, H. E., and S. S. Stahl, 1954, The influence of generalized diseases on clinical manifestations of periodontal disease, *J.A.D.A.*, **49**: 656–667.

——— and ———, 1960, Prevalence of periodontal disease in a hospitalized population, *J. Dent. Res.*, **39**: 439–449.

Schweiger, J. W., 1959, Prosthetic considerations for the aging, *J. Pros. Dent.*, **9**: 555–558.

Seidler, B., S. C. Miller, and W. Wolf, 1950, Systemic aspects of precocious advanced alveolar bone destruction: Preliminary report, *J.A.D.A.*, **40**: 49–58.

Sharp, G. S., 1960, Treatment for low tolerance to dentures, *J. Pros. Dent.*, **10**: 47–52.

Silverman, S., Jr., 1958, Geriatrics and tissue changes—problems of the aging denture patient, *J. Pros. Dent.*, **8**: 734–739.