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Reprint from Northwest Medicine
February and March, 1925

RELATION OF DENTAL INFECTIONS TO HEALTH AND DISEASE

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RELATION OF DENTAL INFECTIONS TO HEALTH AND DISEASE*

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The problem of dental infections has ceased to be of concern chiefly to the members of the dental profession, since the evidence now at hand so strongly indicates that a great many of the present day medical problems have as a contributing factor dental focal infections. We have arrived at a point in the study of factors involved in health and disease as they relate to the conditions of the oral cavity, where we can express quite definitely the forces involved and the routes through which important changes take place. It seems wise therefore that those who are engaged in intensive research work shall from time to time reorient the various phases in the light of the newer knowledge. This is doubly important because of the confusions and misapprehensions of the lay mind which are shared by many of the members of the healing professions.

One of the first fundamental changes in our viewpoint is regarding the route by which mouth infection reaches the system. The contamination of the food by the microbic inhabitants of the oral cavity and the subsequent invasion of the body through the intestinal wall by the organisms of the mouth is a relatively much less important factor

* Abstract of one of three addresses delivered before Idaho State Medical Association, Boise, Ida., June 20-21, 1924.

than we had supposed. So far as the intestinal mechanisms of the body are concerned, the interior of the alimentary tract is an external surface. The mucous membrane of the alimentary tract is equipped with a defensive structure which is quite as resistant to bacterial invasion as the external surface of the body, and it is only through breaks in that epithelial structure that organisms may find ingress into the structures of the body.

No part of the alimentary canal is so subject to breaks in this epithelial mucosa as is the oral cavity itself, in which the breaks come almost entirely around the teeth. If, therefore, the organisms from infected mouths would enter the body tissues, they will probably never find so favorable a location again as the one which they are leaving when they pass from the mouth to the stomach. When, however, there are breaks in the mucous membrane of the alimentary tract, such as occur in colitis, organisms and their products may gain access into the structures of the body. Since, however, the alimentary tract is a common habitat for a great variety of organisms which largely gain access with the food, that part of the alimentary tract, like the mouth, can readily become infected without the necessity of the preliminary culturing taking place in the oral cavity.

Oral infections produce their more or less grave effects on the body by entrance to its structures through breaks in the defensive mechanisms of the mouth. These breaks are in the supporting structures about the teeth and the enamel and dentin of the teeth. The direct and indirect injury of dental

infections constitutes a factor in human welfare which is probably second to no other interest. While it is impossible to state with definiteness in quantitative terms just what that injury is, either in individual lives or in groups of individuals constituting communities, the evidence seems to demand the conclusion that all human efficiency and comfort are reduced on an average more than 10 per cent; and it is not so important just what that percentage may be as it is that a community recognition shall develop of the need for eliminating so far as possible this tremendous human handicap. I shall, therefore, direct our thoughts to the details constituting the evidence for this viewpoint. I shall, if time permits, submit evidence which indicates the following:

(1) That heart disease is a greater problem for community concern and prevention than are tuberculosis, cancer or pneumonia, and an important percentage of heart cases have their principal contributing factor in dental infections.

(2) That other degenerative diseases, such as those of the kidney, digestive tract, muscles and joints, and nervous system have a very much greater causative factor in dental infections than the members of the healing professions have ever anticipated.

(3) That even those other major affections of mankind, namely, tuberculosis, pneumonia and cancer, have in some instances important relations to oral infections.

One of the outstanding incidents in progress in public health matters of the last few decades (dur-

ing which nearly all the progress has been made) is that the tremendous advance accomplished has been almost entirely in the control of the infectious diseases, such as smallpox, yellow fever, typhoid, diphtheria etc. Little or no progress has been made in the reduction of the degenerative diseases, for as a matter of fact, heart disease, kidney involvement, nervous system breaks, etc., are more prevalent with each succeeding decade.

Since Koch demonstrated the organism of tuberculosis, thereby furnishing a dependable means for diagnosis, there have been most efficiently organized and insistently enforced programs of prevention. This, I say, has come about very largely because of the knowledge of the particular bacterium, and it is of particular importance to note that the great progress within two decades, which has reduced the death rate from tuberculosis approximately one-half, has been accomplished almost entirely by preventive measures and in spite of the fact that even to this day no immunologic treatment has been found that will in any large percentage of cases eradicate the disease once established.

Our newer knowledge of the relation of dental infections to the degenerative diseases would make possible the saving of nearly as many lives by the prevention of either heart involvements or kidney and digestive tract involvements as are saved in our preventive measures for tuberculosis; and yet it is an amazing fact that, notwithstanding a heart once involved is not only greatly handicapped but practically doomed to a greatly lessened and shortened efficiency (and the same is largely true of kidney),

almost no effort is being directed specifically toward the prevention of these affections, the entire attention being limited to the difficult, if not almost hopeless, problem of conserving the already injured organ because it is fundamental to life. The point we should stress here is that a heart that has been prevented from having an endocarditis is a hundred times better than one in which the patient has been nursed through a protracted period of incapacity, both because a heart once infected is so likely to be reinvolved and because its unfortunate bearer goes through life with a handicap which reduces efficiency while life lasts, and ultimately nearly always prematurely terminates it.

With regard to this problem of heart infection, when we realize that over one in ten of all deaths in the recorded areas of England and Wales and also in the United States, is from heart infection, and then realize that this 10 per cent has probably had the life efficiency reduced by more than 50 per cent, since so many of them are children whose entire life efficiency has been destroyed, we see that we are dealing with a factor in this one item that constitutes approximately one-twentieth of all human efficiency; and yet, as I have stated, we have no adequate organized campaign against the development of heart disease as we do against tuberculosis and cancer.

Please do not assume that I think that all heart involvements are caused from dental infections. I shall discuss this problem more in detail as I proceed.

Dr. Martin Raven, Medical Officer, St. Mary's

Home, Broadstairs, London, in an article in the Lancet, December 8, 1923, had this to state on this point:

"Although the general public has to a large extent learned to appreciate the modern clinical conception of infective disease, and has in consequence been roused to considerable effort in combating tuberculosis and venereal disease, it is nevertheless not much better informed with regard to acute rheumatism than it was 100 years ago. The idea of a "rheum," causing a painful lodgment in the various parts of the body, where it came to rest, is practically identical with the modern lay conception of constitutional rheumatism, and though it is nearly 100 years since Scudamore and Bouillard associated cardiac lesions with rheumatism, even a well educated man of today, unless he has had personal experience of the disease, is usually unaware of that association.

"Yet to the medical man the disease is daily manifest in patients of all ages. Osler alludes to the 'long arm' of rheumatism, in ascribing to it a large proportion of the 50,000 annual deaths from heart disease in this country (England); and recent figures are still more emphatic. Langmead states that in the London County Council schools there is actually more rheumatism than tuberculosis, and that in the special schools for physically defective children one-third of the cases are cardiac. In 1920 the statistics of the Invalid Children's Aid Association show that they had 996 cases of rheumatism, heart disease and chorea in their charge, as compared with 1401 cases of all varieties of tuberculosis."

I am purposely giving the evidence from other authorities before referring to my own extensive research data, in order that you may see that I am not presenting simply a personal opinion. To quote further from Dr. Raven he states the general position of the disease today:

"The existing uncertainty as to the cause of rheumatic diseases is undoubtedly an important factor underlying the very unsatisfactory staff of officers prevailing in the management of the disease today. One has only to imagine the discovery and bacteriology of a causative organism to be established to

visualize the impetus which would be given to prevention, to diagnosis, to properly controlled treatment, and to the education of the public in the disease. There is no doubt that the established bacteriology of B. tuberculosis has been a great stimulus to the hygienic and clinical management of tuberculosis; the occurrence of the bacillus in milk and in sputum has had far-reaching effects in diagnosis and in the establishment of preventive measures. Similarly the finding of the organism in the tonsils and decaying teeth of children has emphasized the desirability of tonsillectomy and of dental repair in thousands of cases of tuberculous adenitis of the neck. Yet, though there is no bacteriology in rheumatic corresponding to that in tuberculous disease, a great many facts are nevertheless so well established clinically as to justify systematic attempts to control this disease, similar to those already being made in the case of tuberculosis. In 1900 Caton published a series of 86 cases illustrating the preventability of valvular disease of the heart by treatment of rheumatic endocarditis. In America the Society for the Prevention and Relief of Heart Disease has assumed an influential position, and in this country, in 1923, Dr. Poynton has brought forward considerable proposals, in which education of the public takes a prominent place, for the early detection of rheumatic symptoms and the consequent prevention of carditis. Finally, during a discussion opened by Dr. R. Miller at Portsmouth, the Council of the British Medical Association has been recommended to appoint a special committee to consider the best steps to be taken to combat the disease."

Before proceeding with this discussion I wish to prepare you for a new viewpoint. Much progress is always made by relating data and this attitude of mind is most helpful. It is exceedingly difficult, however, to anticipate all the factors involved and, therefore there is great tendency to make incorrect or incomplete associations. To illustrate:

You will frequently see in literature reference to the fact, accompanied by statistical data, indicating that periodontoclasia, or so-called pyorrhea alveo-

laris, is contagious, on the ground that it is generally found that the different members of families all tend to have it or all tend not to have it. My researches have demonstrated that this association of a common experience is related to inheritance of common factors of physical constitution, which predisposes to this condition. I shall not have time to dwell on this here, since I have dealt with it in such extensive detail in my recent work on Dental Infections.*

In that work I have also shown that in the study of the prevalence of heart involvement in 681 families there were more cases of heart involvement in 100 of the families than in the other 581. In other words, when heart involvement appeared in one member of the family, it nearly always appeared in other members, and very often in several. This, of course, is not new, since we have always heard of heart disease running in particular families. The item which is new, however, in my studies is that the susceptibility for heart involvement is a factor quite independently inherited from other lesions of the rheumatic group; in other words this inheritance is a unit character relating to the various tissues of the body. This is illustrated in the following table, taken from Chapter IV:

With this in mind, I wish to quote again from Dr. Raven's article in which he discusses the problem as to whether rheumatic disease is infectious.

"Newsholme, in 1895, spoke of rheumatism as an acute infectious disease, having an epidemic preva-

* Dental Infections, Oral and Systemic, Vol. I. Dental Infections and the Degenerative Diseases, Vol. II. Published by The Penton Publishing Company, Cleveland.

DOMINANCE OF SPECIAL TISSUE LESION IN BOTH PATIENTS AND FAMILIES (TEN)

Group	No. of Males	No. of Females	No. of Lesions in Ten Patients							No. of Lesions in Families							Total		Local Expressions of Dental Infections					
			Tonsils	Rheumatism	Heart	Neck	Nerves	Internal Organs	Special Tissues	Tonsils	Rheumatism	Heart	Neck	Nerves	Internal Organs	Special Tissues	Severe	Severe & Mild	Caries	Pyorrhea	Open	Locked	Rarefying	Condensing
Rheumatism	2	8	5	**10**	2	6	4	4	3	8	**59**	7	9	19	19	10	104	131	9	1	1	6	2	3
Heart	3	7	7	6	**10**	5	7	3	8	12	24	**57**	6	25	13	19	121	156	10	1	2	8	3	5
Nerves	2	8	5	6	2	7	**10**	7	7	10	15	9	10	**142**	28	19	180	233	9	3	3	9	5	5
Internal Organs	2	8	6	4	0	6	9	**10**	6	6	13	9	10	30	**90**	12	136	170	7	3	3	7	4	3

*Type of susceptibility—inherited.

lence in irregular periodicity. It may be asked whether it can be regarded as an infectious disease today. It is now generally admitted that phthisis is an infectious disease. W. St. Lawrence, in New York, made an investigation into the incidence in families of rheumatism and tuberculosis. In 100 families, in each of which at least one member had suffered from a manifestation of acute rheumatism, he found the percentage of cases of actual rheumatism among all the exposed persons to be 14.8; a similar investigation in respect of tuberculosis families, in each of which at least one member had active tuberculosis, revealed the percentage of actual cases among persons exposed to be 14.6, and he points out that it is difficult to evade the proposition that rheumatic disease, and therefore cardiac disease, is communicable to a degree not generally imagined!"

I wish to stress two points here in passing: First, that if infections capable of producing heart involvements are capable of being transferred from one to another, it will be those individuals, who by inheritance have susceptible tissues, who will be involved, and, therefore, the importance of this second observation: It is exceedingly important that these susceptible individuals shall not have carious teeth, through which the invasion of a strain, carrying with it elective localization, may gain access directly to the circulation and therefore to the heart, for I consider the entrance of this type of infection through carious teeth as being a far more accessible route than through the alimentary tract by the contamination of food, or through the mucous membrane of the nose and respiratory tract.

With regard to the matter of the reinfection of the heart, Dr. Raven reports on a group of eight children who received from six to twelve weeks quiet life by the seaside.

"They had all originally had chorea; in no case was tonsillectomy performed. They were reexam-

ined after at least six months' life in London and daily school attendance, the results being as follows:

3 cases, heart normal; no more chorea.
1 case, heart normal, but chorea recurred.
3 cases, signs of myocarditis (excitable beat and dilatation, fresh chorea.)
1 case, aortic regurgitation.

"Out of eight cases, therefore, who had had a short stay on the seacoast, five showed recurrence of rheumatic symptoms."

It is fair to suppose that, if these children did not have tonsillectomies, they did not have dental care. Note that five of the eight, or 62 per cent of these susceptible individuals had already seriously broken in six months when taken to that environment. Do you not rebel in your very heart against the subjecting of these poor innocent but susceptible creatures to this almost inevitable doom? And yet it is just what the world is doing with its young life today. In the light of our extensive researches I would say it is practically a physical impossibility for a child with a high susceptibiilty to heart involvement to carry infected deciduous teeth and live in an environment of chilling dampness and lack of sunshine and escape heart infection, as these clinical data have demonstrated. The great majority of such children are as surely doomed to handicap, if not premature death as the child that is exposed to smallpox, diphtheria or tuberculosis, for which latter we have a public conscience, but for the former we are still largely in our primitive state.

I must not spend too much time in the discussion of heart involvements, but before leaving it I should discuss the newer view of the bacteriologic phase of these disturbances. This is not the time

and place for a detailed analysis of the different types of carditis and the various contributing factors. You are doubtless all familiar with cases of heart disease caused by pneumococci, staphylococci and gonococci. We are particularly concerned with the two types which are referred to as the *acute* and *subacute* forms, cases lasting for six weeks or more being classified as the *subacute* by Libman who is one of our splendid authorities. The subacute cases constitute a large majority of heart involvements. Libman states that the subacute cases are due in about 95 per cent of cases to the so-called streptococcus viridans. The remaining 5 per cent are nearly all caused by the bacillus influenza.

In this regard I wish to call your attention to two outstanding items of the newer data. In our cultures from dental focal infections, taken from the tooth structure or pulp chamber, more than 95 per cent have proved to be streptococcus viridans, which is a group name for the different strains of streptococci which produce green colonies when grown on blood sugar. From a few of these cases we have grown an hemolyzing streptococcus. Libman states: "The cases of bacterial endocarditis that run an acute course are due most commonly to hemolytic streptococci, pneumococci, staphylococci, and the gonococcus, but can also be caused by a great variety of other organisms."

We have frequently found, as I have demonstrated in the work above referred to, hemolyzing streptococcal strains in vital pulps which when inoculated into animals, produced large percentages of

death from heart involvement. In one case thirty animals were inoculated and 93 per cent developed acute endocarditis, from which the boy was suffering from whom it was taken and from which he died within six months. The pulp of this tooth was nearly but not quite exposed by deep caries in a first permanent molar also almost normally vital though infected, and had a history of one attack of acute toothache. This was his first attack of heart involvement; and had I time to go into detail, the evidence seems strongly to indicate that the dental infection was the cause of the boy's death.

There is a phase of this problem of heart involvement that is very important and should be discussed at this time. I am meeting weekly in business and on the streets, patients who are carrying on business with hearts functioning so splendidly that they appear to be relatively normal, who had so serious heart involvements as to make their lives despaired of, but whose improvement seemss to have been entirely due to the removal of dental focal infection. With regard to this new emphasis on the hopefulness of helping many of these already affected individuals, Libman states in the conclusions of his article in the *Journal of the American Medical Association* for March, 1923, as follows:

"It is evident that I have presented the subject of the characterization of the various forms of endocarditis in a very broad way only. It is realized that the various subjects that have been discussed must later be taken up in a more detailed fashion. One thing is clear. It is evident that the disease which was considered rare, subacute bacterial endocarditis, is now recognized as one of the common diseases. Of great interest is the change in our point of view. It was supposed to be a practically uniformly fatal

disease. Now we are observing more and more partial or complete recoveries. We find that very mild cases exist, and that there is a recurrent form of the disease. In other words, the interest is shifted toward the question of healing. It will be of the greatest value, if an active campaign is undertaken for the purpose of preventing this as well as other forms of endocarditis."

Let us call your attention to the fact that, since it has not been recognized that the most prolific source of infection for the production of cardiac infection was from dental sources, since 50 per cent of all individuals carry teeth potentially capable of doing this at most any time that their resistance is lowered, and probably over 90 per cent of individuals have such a source at some time during their lives, we are thrown back upon the problem of inherent defense, a factor that we have not appreciated in the past. I am not presuming to review these various phases in exhaustive detail but only sufficiently to emphasize their individual importance, and I shall again refer to the heart involvements in connection with other phases of this discussion.

We shall next discuss the oral focal infections in relation to arthritis. This affection presents in both acute and chronic forms, and the chronic forms are of two distinctive types—the *degenerative* and the *proliferative*. Ely of San Francisco, in discussing The Second Great Type of Chronic Arthritis in the *Journal of the American Medical Association,* November, 1923 refers to its prevalence in the following words:

"In the orthopedic clinic at Stanford it is by far the most frequent disease with which we have to deal. Established always with the roentgen rays, its diagnosis comprises more than one-tenth of the diagnoses in our clinic."

He further states that:

"A very large proportion of the so-called sciaticas owe their origin to spinal arthritis."

With regard to the prevalence of arthritis, some clinicians have become very positive in their conviction that the teeth play not only an important part but by far the most important part as a source of focal infection. Sir William Wilcox and Dr. Beddard, both of England, place as high as 90 per cent of the cases of non-specific infective arthritis which are due to infections arising from the teeth. It is, indeed, difficult to state in any particular case that any one source of infection has been the only source. My own extensive clinical practice, specializing in the diagnosis and treatment of systemic involvements arising from dental focal infections, has brought me to feel that in many communities the percentage is as high as placed by Drs. Wilcox and Beddard.

Probably no single contributing factor to focal infection of dental origin is so frequent as is overload, which may take many forms, none of which, however, are more potent than the physical stress of pregnancy and lactation. Given an individual who is susceptible and an overload of pregnancy, influenza, and a source of dental culture, such as a chronically infected tooth, the probability of the development of an arthritic process becomes very great and no mother so affected can give to her offspring the proper calcification of teeth and bones to insure its maximum efficiency either in childhood or later life. We too often think of the care of the mother in terms only of her physical comfort.

As important as that factor is, we will be doubly concerned that she shall not have a source of focal infection competent to develop an arthritic process when we realize that her handicap is not limited to her own body in its complications but handicaps the new life which to her is more sacred than her own. I am familiar with the details, by intimate personal acquaintance with many bedridden cases of deforming arthritis because of my effort to assist them in securing improved health, and it is a most lamentable fact that the majority of them furnish a history that demonstrates that the process began during pregnancy, at which time they were carrying infected teeth.

In the foregoing I have discussed only two types of systemic lesions which may readily be related to dental infections, and I could similarly present the case from a standpoint of the degenerative disesases affecting the nervous system, both general and central, kidneys, digestive tract, pelvic organs, skin, eyes, etc., which time does not permit. For example, some oculists attribute 75 per cent of eye involvements of most frequent types to dental focal infections. Some even make special lesions, such as arthritis, 100 per cent of dental infection origin. In the insanities we find an abundant literature as well as a large personal experience, indicating that a great many cases of both mild and grave cases of psychoneurosis have their chief contributing factor in the development of the onset in dental focal infections. You are doubtless familiar with Dr. Cotton's work in the state asylum of New Jersey, in which he has found focal infection to be the

most important contributing factor, and of which the dental focal infections are by far the most frequent.

If it were possible to determine in any community or in any individual the entire total effect of dental infections on all phases of vital efficiency as well as longevity we would find a sum total that would amaze even the most sanguine. I will try to visualize this for you in a general way only for it is clearly impossible to give specific data. Dr. Louis Dublin, statistician of the Metropolitan Life Insurance Company, than whom there is probably no higher authority on matters of life extension, has recently presented in the Harvey lecture before the New York Academy of Medicine a new analysis of the available vital statistics.

He states that the average length of life in this country today is 51.49 years, which is known as the life expectation, which is 12.5 years more than it was seventy years ago, and that in the state of Massachusetts during the past sixty-five years there has been a gain in life expectancy of 15 years. If we assume 70 years of age to be a fair maximum that we should work to, it will be noted that we are approximately 18.5 years short of that point, and it is of particular importance that he, as others, has stressed the fact that diseases of the heart and kidney are not declining, regarding which he is reported in Hygea for February as follows:

"In analyzing the various attempts that have been made to prolong life and to decrease mortality at various age periods by the control of infectious disease and by periodic physical examinations, Dr. Dublin concludes that it is possible to attain large results in increasing life expectancy in the future. Although

diseases like tuberculosis have declined greatly, the conditions that reflect personal hygiene and the general care and use of the human body, such as heart disease, Bright's disease, and other diseases affecting middle life, are not declining."

That this is one of the most important problems confronting preventive medicine today, was strikingly brought out by Dr. Livingstone Farrand, President of Cornell University, in his address on the Nation and Its Health, before the American Association for the Advancement of Science at its Boston meeting a year ago. Science, in abstracting his address, stated:

"Dr. Farrand reviewed the progress of public health work in this country and pointed out that since 1870 the average length of life has been increased by fifteen years, that marked reduction has occurred during this period in infant mortality and in mortality due to tuberculosis, typhoid, smallpox and many other diseases. The efforts of health workers and organizations have, however, been unable thus far to prevent increases in certain unconquered diseases, such as cancer and diseases of the heart and kidneys. The most outstanding problem at present concerns the control of the degenerative diseases of later life, an increase in mortality from these being an inevitable consequence of improvements in the control of diseases of infancy and youth."

We find, then, that since the epidemic infectious diseases have been controlled our hope for further improvement lies almost wholly in our learning to control the so-called degenerative diseases. Dr. Chas. Mayo has stated in his address before the New York State Medical Society as published in the Dental Cosmos of November, 1922:

"Probably 90 per cent of deaths are due to infective diseases and the other 10 per cent to accident, failure of development before birth, and the degeneration after birth, and so on."

Where do these infections come from? He and many others have stressed the fact that these infections, which strike the final blow, come from focal infections which the individual is carrying at the time of the stress or overload. My intensive researches for the past two decades have been concentrated quite largely upon the problem of determining the role of dental sepsis in producing these contributing infections. In this work we have used in the last three and one-half years about 1300 rabbits besides a large number of other animals. This work has been so organized that every department has been dovetailed into the others in such a way as to bring about the maximum possible efficiency and cooperation of a staff ranging up to eighteen individuals. This has included the intensive physical, clinical, and laboratory study of thousands of patients. The results compel the conclusion that dental focal infections constitute a very important factor in the etiology of the degenerative diseases, and in very many instances the evidence seems to compel the conclusion that the dental infection was the all-important factor. I shall present illustrations of various types of degenerative diseases and submit evidence which has indicated the importance of the dental source.

But this raises the question as to why some individuals with infected teeth and with unusually large quantities of dental infection have no known systemic involvements, and others with apparently much less dental infection, or none at all, do have particular systemic involvements. These researches have demonstrated that the most important factor

next to that of the invading organism (and perhaps, we should say even more important), is the factor of specific defense of the individual's body against invasion for every organ and tissue of that body. In order to determine this factor I have made detailed studies of over 1400 individuals and their families to determine the presence or absence of rheumatic group lesions of the types that our experience indicated might be related to focal infections, such as dental focal infections. Necessarily, it was impossible to get complete data in all cases and, accordingly, we have selected 681 family charts as being sufficiently complete to justify making deductions.

This work has shown that individuals can be divided readily into three groups with regard to their susceptibility or absence of susceptibility to rheumatic group lesions. I have termed these groups: susceptibility *absent,* susceptibility *acquired,* and susceptibility *inherited.* When we add all the rheumatic group lesions in a particular family we will have those of the patient, the brothers and sisters, the father and mother, the father's brothers and sisters, the mother's brothers and sisters, and the four grandparents, which makes on an average fifteen individuals. We have taken as the rheumatic group lesions for classification: Tonsillitis, rheumatism, heart, neck, nerves, internal organs, and special tissues, as units. The total number of all of these lesions in all the members of the family classified as susceptibility *absent* is 4.2; in the family with susceptibility *acquired* it increases to 6.8; and in the group classified as susceptibility *in-*

herited to 15.5. In this grouping we have only included the severe expressions such as would destroy life or incapacitate the individual. When we include both severe and mild expressions of the affections we find the figures for susceptibility *absent,* 7.08; for susceptibility *acquired,* 10.7; and for susceptibility *inherited,* 21.11. It will be noted, then, that in families with an inherited susceptibility there is three times as much danger of systemic involvement as in those with an absent susceptibility.

Let us now study this inherited group with regard to the possibility of focal dental infections. If we divide individuals into groups as follows: Absent, acquired, inherited, and the latter into four divisions, one side mild one side strong, two sides mild, and two sides strong we have the remarkable result, when we study the relation of dental caries to their problem, that in general that lesion increases directly in proportion with susceptibility; whereas, the percentage of individuals studied, that were classified as having an absent susceptibility, showed 40 per cent, those with an acquired susceptibility 80 per cent, inherited one side mild 67 per cent, one side strong 80 per cent, two sides mild 93 per cent, expressed, when we study the relation of caries to susceptibility in 681 individuals we find that 73 were classified as *absent* susceptibility, 130 *acquired* susceptibility, and 327 *inherited* susceptibility. The balance did not have caries.

Another grouping of individuals, for which 100 individuals were selected, developed the same general information but with slightly different figures:

	Having dental caries
Dental patients with no developed susceptibility	51 per cent
Dental patients with an apparently acquired susceptibility	91 per cent
Those with a susceptibility and with one or both parents acting as carriers only	81 per cent
Those with a susceptibility and with only one side of ancestry, including that parent, involved	88 per cent
Those with a susceptibility, including both sides of ancestry and both parents involved	100 per cent

When we relate this factor to rheumatic group lesions, which constitute a large part of the so-called degenerative diseases, we get this remarkable result that when we select fifteen typical families for each of the six groups—absent, acquired inherited one side mild, one side strong, two sides mild, and two sides strong—the number of severe lesions in the entire fifteen families is as follows: 16, 63, 144, 258, 227, 483; or when we include the mild as well as severe expressions, the figures become: 31, 96, 201, 338, 308, 754.

It will accordingly be noted that susceptibility to the rheumatic group lesions increases at a greater rate even than the susceptibility to caries, and the susceptibility to caries is so dominant a factor in those with an inherited susceptibility that in strongly inherited groups it is from 90 to 100 per cent. Now when we consider that of these individuals with so marked a tendency to caries a very large percentage will at some time (and with many of them at all times) have present in their bodies pulpless teeth, potentially capable of producing any of these lesions, we have an association of causative

factors that is final and absolute except for one factor namely, the demonstration that such teeth are potentially capable of producing or have produced, the lesions in question. For this latter point, which is the last phase of this question to be clearly demonstrated, we will furnish (by lantern slides) as evidenced these two factors: the capacity of the organisms selected from the dental focus to produce the lesion in question which that host presented with, and the improvement in the host's health by the removal of the dental focal infection. For this latter I will use illustrations, the sum total of which evidence seems to leave no possible escape from the conclusion that dental focal infections constitute by far the most important source and by far the most important causative factor in the development of the degenerative diseases of the rheumatic group.

Of the other degenerative diseases, such as tuberculosis and cancer (if we may consider them as such), our researches have demonstrated clearly certain data which throw a new light upon the nature of those disturbances, though, let me state in anticipation of your making any mistaken conclusions, we do not have evidence that either tuberculosis or cancer are directly caused by focal infections. In our extensive tabulations, in which we have found it relatively simple to classify people according to the types of their dental pathology, we do find that, where cancer has appeared in the family and in the studied individuals, in about 75 per cent of the cases it has been in one group classification, namely, those with an acquired suscepti-

bility. Time does not permit of a discussion of this point here except to state that there is some evidence, as I have brought out quite clearly in the chapter on "Precancerous Conditions" in my recent reports, that focal infections may produce sensitized states in tissues, which may take on a distinctly pathologic form and which there is some evidence suggesting may become precancerous conditions.

With regard to tuberculosis, a very important group of new data has been developed in these researches, namely, that patients who prove to have a poor capacity for combatting tuberculous infection are in very large percentage in the group with an active capacity for decalcification as expressed in periodontoclasia, or so-called pyorrhea alveolaris, which patients do not in this condition tend readily to have calcification processes develop within their tissues. I have studied this matter in tuberculosis institutions and find much evidence in support of my experimental data and very little contraindicating it. It is entirely possible, and indeed probable, that the establishment and continued presence of extensive gingival infections aggravate this very condition and in that way decrease the individual's specific defense. I have discussed this at length in the chapter on "Respiratory Tract."

Since dental infections constitute so important a factor in health conservation, its prevention is a problem second to none in the interest of humanity of today, and a problem which has an increasing imperativeness in the communities with the so-called highest intelligence, since with our modern methods of preparing foods and ideas regarding its selection,

as generally practiced, dental infections are many times more prevalent than in the more primitive state. This leads to the question as to how efficient oral prophylaxis, as practised really is. In this regard two items are outstanding:

The first is that enormous betterment is achieved by the use of even the methods and knowledge at present available. To be more specific, it is probable that a small percentage, possibly 10 per cent, of the people of the United States have reduced their dental infection 50 per cent. Personally, I am very sure this is too high, but granting it it means that only one-twentieth of the dental infection is being removed or prevented. Immediately we ask ourselves: What does this mean? Some of the factors involved are easily discerned. The most important of course, is ignorance, for the knowledge that is available is but poorly practiced.

A second factor is the delay in the development of an adequate basis for judgment in the minds of the members of the healing professions. I think no phase of this latter problem is so convincing and pathetic and almost disheartening, namely, the lack of oral prophylaxis as a part of the health program for invalids in our institutions under medical and dental care. It is almost inconceivable that with the knowledge available at this time, many hospitals do not have any routine dental service. Notwithstanding that it has been demonstrated that in those hospitals that do have a proper organization for the identification and elimination of dental focal infections and a staff of periodontists to maintain a relatively clean condition of the teeth and mouth,

the average stay of the patients is sufficiently shortened to reduce the expense to the community for maintenance of the hospital in an amount which is several times greater than the expense for the establishment and maintenance of that service.

Another evidence of the delayed recognition of the importance of these factors is clearly demonstrated by the number of members in the healing professions who have in their own mouths teeth potentially capable of doing them serious harm, and who, we must assume, do not recognize that danger or they would not be there; and this is not strange when we realize the slight importance which these problems must be assumed to have, as judged by the amount of effort that is being made to acquire new light through adequate research. Nor is this a problem that concerns only or primarily the members of the healing professions. It should not be up to them to furnish the money and the institutions with which to carry on adequate research on these dental problems.

In most any audience or group of individuals it might with considerable correctness, as based on mortuary statistics, be stated just about the number of individuals of the group who would die of the special disease. For example, we might safely assume that the people of this audience will many of them have their lives foreshortened and their comfort and efficiency, even during their period of life, reduced very materially below the possible maximum span of life that would even be possible, nothwithstanding the bad management of our lives in the past. If we knew, for example, that 5· 10, or 15 per cent of the

individuals here would die of each heart, kidney, digestive tract nervous system, and special tissue involvements, with approximately 10 per cent by accident, and if we could know just which group we would likely be in, would we not make some adequate effort to see that that misfortune did not strike us?

We can understand the helplessness of animal and bird life to plan for defense against their greatest enemies. We can even understand this for the primitive tribes in undeveloped civilizations, but it is hard to feel that this generation of Americans will go complacently along and not adequately try to save its own generation or the next for which it is so directly responsible and which it should love as dearly as itself. Surely the shell of civilization is not very thick, for all that is needed is a mere fraction of the expenditure that is made for luxuries for passing amusement, which, expended intelligently in research work in dental problems, would move forward the time when this knowledge would conserve human life and efficiency by generations. Instead of a handful of individuals struggling with a problem a thousand times too great for them to handle alone, and with all too meagre facilities and no adequate financial support, and even without cooperation, there should be millions of dollars available for the engagement and training of hundreds of skilled workers, working under conditions that would conserve their health and maintain efficiency. I have not the slightest doubt that for each million dollars that would be expended there would be a million years added to the sum total of efficient and comfortable life to the citizens of America.