DEPARTMENT OF DENTAL AND ORAL RADIOGRAPHY

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A RADIOGRAPHIC STUDY OF BONE REGENERATION FOLLOWING APICOECTOMY

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THE problem of pulpless teeth has been one that has occupied the attention of the dental and medical profession during the last few years, and a large number of operations and technical plans for treating pulpless teeth have been devised by different men. To a certain extent one might divide these various plans of treatment into what can be termed therapeutical and surgical.

Under the head of therapeutical methods, would be included various plans of medication which have for their object the treatment of the pathological condition at the end of the root whereby the tissues are placed in such a state that Nature is able to change a pathological condition to one that is physiological.

It must also be remembered in this classification that surgical means enter into the therapeutical as far as actual treatment of the pulp canal and its filling is concerned. Under the surgical means we may include such methods as recognize a pathological condition at the end of the root and take the view-point that the quickest way to eradicate pathological tissue is removal by surgical methods, allowing Nature to heal or regenerate new tissue after the surgical operation.

The surgical method has many advantages because it is founded upon sane and safe principles which include the removal of all infectious conditions when known to exist. The surgical operation may be apicoectomy, which includes the removal of a portion of the apex of the tooth, or it may, in some instances, consist of simply a removal of the necrotic and pathological bone around the end of the root, leaving the end of the tooth intact. Of course in the surgical treatment of infected areas at the apex of teeth the pulp canal must be surgically clean and filled.

The surgical removal of infected material at the end of the root also including the actual removal of a portion of the root is an operation upon the value of which the dental profession is divided. Men who have developed

a fine therapeutic plan of treating pulpless teeth are opposed to anything that resembles surgery. A man who is surgically inclined is also liable to place too much weight upon operative treatment of infected areas. Nevertheless, if both plans are given their proper and due consideration, I believe in the majority of cases, where the infection is to any degree extensive, that the surgical procedure offers the patient more relief and more hope of permanent relief than does the therapeutic method. The surgical method is more logical.

I make this statement realizing that men claim the surgical treatment of infected areas at the end of the teeth is out of "date" and as some say, out of "fashion." Nevertheless, surgical principles still exist in the treatment of pathological conditions.

The other day in conversation with an exodontist, I said that I had seen many excellent results in the surgical treatment of infected apical areas. The exodontist replied, "Yes, and I have extracted many of those 'excellent' results." He made the statement as if the fact that he had extracted teeth upon which apicoectomy had been performed, condemned the operation as a failure. Such an argument is not logical because the undertaker eventually buries every patient who has had a surgical operation. In fact the undertaker also buries the people that have never had surgical operations. Likewise one might say that surgery was a failure because the patient eventually died even though he may have died thirty or forty years after the operation, from an entirely different disease.

Many of these teeth upon which apicoectomy is performed are eventually extracted because of other pathological conditions; because they are finally extracted does not mean the apicoectomy was a failure. Exodontists extract teeth which have also been treated by therapeutic measures; they also extract teeth that have had no treatment whatsoever. In fact, the future of most teeth is that they will be extracted provided the patient lives long enough. So for any one to say that apicoectomy is a failure because the tooth has been extracted is drawing a conclusion which is by no means logical and which is entirely unfair to the operation, and if such comparison is going to be taken as a basis we might as well say that all dental operations are failures, even to the filling of the cavities because teeth that have cavities filled and have vital pulps are often extracted some time in the life of the individual.

The surgical treatment of infected areas at the end of pulpless teeth is in keeping with the knowledge of modern surgery and pathology and is a much safer method of treating many of these conditions than is the therapeutic method in attempting to eliminate all of the infection through the small opening of the pulp canal.

There is another question in regard to the surgical treatment of infected areas including apicoectomy which has received much discussion; that is the regeneration of bone in the surgically treated area. I can remember a few years ago when a number of men insisted that the bone never regenerated in those regions. It seems to me that such a statement as that was

only the result of ignorance in regard to physiological development and growth of bone.

In any region of the body where there is a healthy bony surface that is not in contact with soft tissue, the bone will regenerate and fill that space. Experiments in the development of bone carried on by investigators prove that healthy bone will regenerate provided activity is not limited by pressure.

After the radiogram became more common and it was possible to make radiographic studies, it was clearly demonstrated that osseous tissue filled in these spaces from which necrotic tissue had been removed. Then we find a new word crept into dental nomenclature and men spoke of this new bone as being "sclerotic." From a histological standpoint it is rather a difficult thing to define "sclerotic bone" but we presume that the men who originated that term mean that this bone is "sear bone" as distinguished from normal bone.

I have never known of a clear and scientific definition of sclerotic bone based upon histological characteristics. Sclerotic bone is nothing more than compact bone which is the first type of bone to form in regeneration or bone repair. This bone which forms at the apex of a tooth after a surgical operation is exactly the same type of bone that would develop on the body of the long bones if the periosteum was lifted away from the body of the bone and a space was allowed to exist between the shaft of the bone and the periosteum. This nodule of bone which would form under the periosteum would have the same histological characteristics as the bone that developed at the end of the tooth after apicoectomy, and the x-ray would picture it as being denser and more compact and practically devoid of cancellous structure. The circulation and nutrition would consist of what could travel into the bone through the canaliculus of the bone cell. In other words this nodule of newly formed bone is practically devoid of cancellous formation and medullary spaces which means no capillaries or circulation exist in it at that time.

This new compact bone is the result of bone cells being thrown into the space from the pre-existing bone and consequently they form a more dense bone than that which has existed a longer period of time and has been absorbed and rebuilt so as to produce the cancellous and medullary forms. The bone which forms at the end of a tooth after a surgical treatment of infection is the same as the new bone that forms at the fractured portions of the long bone and can be easily understood if one has devoted time to the study of a large number of histological sections showing the growth and development of bone in the embryo and bone of various ages and the different manner in which it stains in histological preparations.

It must also be remembered that the very life of all bone consists of constant rebuilding and absorbing in all parts of the body. Bone recently rebuilt is compact bone and shows the same appearance as the so-called "sclerotic" bone. After we have considered this early form of bone in the surgically treated areas which is always dense, it is well to study the further change in this structure. If a series of these cases were studied it would eventually be found that this compact bone disappears and is replaced by cancellous bone

which has the same appearance as the rest of the alveolar structure. Of course it takes some time for these changes to occur because it takes a considerable period of time for a bone which has been fractured to develop to the point that the line of fracture is not discernible in the radiogram or histological section.

It is rather surprising to some of our friends who are opposed to surgical treatment of pulpless teeth to know the rapidity with which this new bone regenerates and assumes a normal physiological appearance as portrayed by the radiogram.

The following three cases show some interesting features in bone development following apicoectomy. It is needless to go into the various technics

Fig. 1-A.—December 15, 1920.

Fig. 1-B.—December 15, 1920.

Fig. 1-C.—October 31, 1921.

employed in treating these cases, for I am only analyzing the histological significance of the radiograms as shown in three cases.

Fig. 1 shows a case which on December 15, 1920, presented with pulpless teeth with a considerable infected area at the end of the root. The second picture (*B*) shows the case immediately after operation. It will be seen that a considerable portion of the bone has been removed and that the ends of the roots have been cut off. Fig. 1-C, which radiogram was made October 31, shows the bone as regenerated, and it has already assumed a cancellous appearance. If a radiogram of this case had been made four or five weeks after the operation, we would have found that the area from which the necrotic bone had been removed, was filled with a much denser bone than we find on October 31, 1921.

Fig. 1-C shows a condition at the end of the root in which a space seems

to exist between the end of the root of the bone. The future of this space is a matter of more or less discussion, but I do not believe it has any pathological significance and only exists because of the fact that the Human Family has evolved to a point where bone and dentine do not unite the same as they do in some of the lower animals. I believe in many of these conditions there will be a regeneration of cementum over the end of the root from the gradual creeping up of the cemental organ the same as the bark grows over a tree where a portion has been removed.

I saw a histological section in the possession of Dr. Hecker a few years

Fig. 2-A.—March 26, 1920.

Fig. 2-B.—March 26, 1920.

Fig. 2-C.—October 15, 1920.

ago which showed an accidental fracture of the end of a root, the same possibly unknown to the patient, in which the cementum had grown over the tooth and root portion which remained in the tissue. How long this fracture existed no one knew, because the specimen was obtained from the dissecting room and no previous clinical history could be obtained, but it proved conclusively that the cementum was a constantly growing tissue which if in a pathological condition would cover dentine such as the end of the root where the dentine has been exposed as a result of the apicoectomy.

Fig. 2 also shows three views. The pictures *A* and *B* are before and after

the operation. *C* shows the case on October 15, 1920, in which the bone has regenerated and assumed a decided cancellous appearance and which has every indication of being a perfectly physiological bone.

Fig. 3 is also another case in which the first two pictures *A* and *B* are made immediately before and after the operation. Fig. *C* was made on November 17 and shows a regeneration of bone which so far as density and cancellous arrangement is concerned, is normal. The socket of the tooth is also climbing over the edge of the root which would indicate that the cementum is gradually developing around the apex of that tooth and will eventually cover the exposed dentine completely and with the regeneration of a new periodontal membrane you will have the same appearance at the end of that tooth that we find in some patients where the roots of the teeth are short and undoubtedly have failed to develop to the proper length. In some instances the bone unquestionably has been absorbed and followed by the regeneration of the cementum and the periodontal membrane of that area.

Fig. 3-A.—April 23, 1920.

Fig. 3-B.—April 23, 1920.

Fig. 3-C.—November 17, 1920.

In speaking of the absorption of the teeth, why this absorption occurs in the permanent teeth we do not know, but it does occur normally in the deciduous teeth and we find a portion of the root may be absorbed and the cementum and dentine removed to a certain depth and later the cementum will be entirely developed over the dentine in that region. Such conditions as that were shown by Dr. Black by his work on the periodontal membrane. Specimens made by other men showed the same condition. The radiogram interpreted in the light of modern histology reveals the same in the permanent teeth. I think this absorption in some instances may be produced by improper orthodontic treatment and in other cases it occurs for unknown reasons at the present time. Viewed, then, in the light of modern histology and in keeping with a knowledge of bone development, everything indicates that the surgical treatment of infection at the end of the teeth is perfectly logical and holds out a great degree of success.

The bone regenerated after surgical operations will show different radiographic appearances depending upon the length of time after the operation that the radiogram is made. Also these various changes in new bone area are the same as would occur in normally developed bone in any part of the body. It is our opinion that the so-called "sclerotic" bone is only a compact bone that always develops in any part of the body where the bone cells develop in great numbers as they do in the space created by surgical treatment of the infected area at the end of the teeth.

TECHNIC FOR DENTAL RADIOGRAMS WITH INTRABUCCAL FILMS*

BY NADAUD (OF COLMAS)

THE surgeons and dentists in France seem to avail themselves less and less of the valuable and indispensable information which the systematic use of the x-ray might furnish them. The radiographic examination of the pathology of the teeth and maxillae is divided into the three following radiographic methods, which is far from being an objection, as each have their advantages.

1st. External method, with the extraoral plate and projecting on this plate each side of the maxillae, separately.

2nd. Internal method or intrabuccal, originally described by Costa and Sinclair, perfected and named "the method of horizontal projection by Dr. J. Belot."

3rd. Internal, intrabuccal method by direct projecting on the films.

In this article, we have especially in view the use of this latest method which several of our scholars, such as Jaugeas and Albert-Weil, it seems to us, have either discredited wrongly or have presented as very complicated. Our purpose here will be to determine the characteristics of a simple and convenient technic which, without any special appliance, will always furnish us with excellent results and which others, with a few differences, have used with certainty before us.

TECHNIC

We use x-ray films with a double-emulsion, the films being cut to the desired size in the dark-room. The sizes we use are 2 cm. by 3 cm. for taking an individual tooth and 4 cm. by 5 cm. for taking several teeth at a time (general size 3 or 4 cm.).

1. *Packing*.—Each film, as when utilized, is carefully packed in a small rectangular sheet of black opaque paper which is folded two or three times over the film and whose slightly overlapping borders are turned back of the film once it is folded. The entire thing is again enveloped in a new rectangle of

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