

## A Method of Sterilizing, and at the Same Time Impregnating with a Metal, Affected Dentinal Tissue.\*

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WE have found the treatment about to be described effective and of broad application, as follows:

I. It is effective in the sterilization of the disintegrated dentin overlying pulps, as in the large cavities of carious first molars.

II. By this method it is possible to completely sterilize not only a putrescent pulp without removing it, but also the dentinal structure of the root as well.

III. In acute pericementitis following the death of the pulp it is only necessary to pump this material into the pulp chamber and into the canals as well as possible and close the tooth. The pericementitis in such cases as we have treated has been quickly allayed, and a subsequent and more thorough application has apparently ended the trouble.

IV. We have found it effective in the treatment of chronic abscesses; indeed this treatment was developed largely for these special cases. The loss of the first or second molar means so much to a child that we attempted to find a simple, rapid, and effective method of treating these teeth in a large clinic.

V. We believe this to be a most admirable means of taking care of apical foramina in all cases if properly used. It is also applicable in cases where a slight apical sensitiveness exists, due to a small piece of pulp tissue left after removal of that organ during infiltrative or conductive anesthesia.

VI. It is an excellent means for almost painlessly disposing of the remaining part of a pulp after the death or removal of a portion of it. For example, it frequently happens that one root in a molar retains some degree of vitality, while the rest of the pulp is dead. This method effectually disposes of the remaining nerve shred.

VII. Applied to the root-end after apicoectomy it lessens the probability of subsequent trouble.

In all these cases this method does more than sterilize the tissue. It fills it at the same time. It permeates any affected dentin, and fills it with metallic silver in a wonderfully perfect manner.

### PREPARATION OF THE MATERIAL AND METHOD OF USING IT.

Two solutions are required:

*Solution 1.* This consists of a saturated solution of silver nitrate in water to which is added little by little strong ammonia. As the ammonia is added a dark precipitate of silver oxid is thrown down. This is soluble in excess of ammonia, therefore continue adding the ammonia until the solution becomes clear.

*Solution 2.* This consists of a twenty-five per cent. solution of formalin in water.

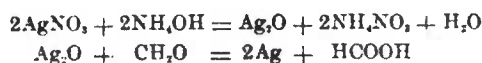
These two solutions must be kept in separate dark-colored glass bottles, with glass stoppers, and should be away from

\* The substance of this paper was presented in the form of a lecture before the Pennsylvania State Dental Society, Philadelphia, June 26, 1917.

the light as much as possible. They work better if they are freshly prepared, but are still good after a considerable time if kept as recommended.

The principle is that of silver reduction. Metallic silver is thrown down in a very finely divided state. It is deposited upon the sides of a clean test tube as a mirror. The principle is used in photography and in staining methods in histology. The action in the tooth is the same. A finely divided deposit of silver in its metallic form occurs wherever the liquid penetrates. By successive applications a very appreciable thickness of deposit occurs. This may be burnished and made to take on the luster of the metal.

The reaction in this method is as follows:



Formic acid acts readily as a reducing agent, taking away O, and forming carbonic acid  $\text{H}_2\text{CO}_3$ , which decomposes easily into  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . We have then practically metallic silver and nothing else. The reaction sterilizes, as we have ascertained by repeated examinations, and at the same time leaves this heavy deposit of metallic silver in a fine state of subdivision, which penetrates all affected dentin but does not penetrate the sound tissue of the teeth.

The method of procedure is very simple. Such slight changes as are needed to make it adaptable to different localities in the mouth can readily be solved by the ingenuity of the operator. We shall describe some of these in our discussion of specific cases.

It is better to apply the rubber dam or to protect the tissues in some way. Any applicator will answer the purpose for conveying the liquids to the cavity. Broaches wrapped with cotton will serve the purpose. In the clinic here we use two pieces of glass tubing: these we prepare by heating a piece of small-bore glass tubing in the middle, and by drawing it out to a capillary. With a file this is then broken in the center. One

tube we keep for the ammoniacal silver solution and the other for the formalin. If the solutions are of sufficient depth in the stock bottles, the liquid will collect in the capillary end of the tubes, or it can be drawn up into the tubes by suction. The fluid can be retained and controlled by placing the finger over the large end of the tube. Tubes with curved ends are used for the upper teeth.

A tube of solution 1 is taken, the capillary portion filled, the finger placed over the end, and this is conveyed to the cavity. By momentarily raising the finger a small drop of the silver solution is allowed to flow into the tooth. A small drop of solution 2 is now flowed in, the solution darkens, silver is reduced and is deposited upon the surface. After

a few moments absorb this solution and repeat the process, in order that more silver may be reduced and deposited.

It is well to protect the hands with rubber gloves or to wear finger-cots. Throughout the treatment the silver that is deposited in the dentin is black. It is no longer silver nitrate; it is no longer formaldehyd; it is simply metallic silver that is deposited, with the formation of weak formic acid, which latter is readily converted into  $\text{CO}_2$  and water. Sound dentinal tissue does not discolor, but any defective tissue appears jet black. Any tooth, even an anterior one, can be protected from the discoloring effects of these solutions by a coating of adhesive wax. By neatly cutting away the wax the treatment can then be applied at the point where it is indicated.

So much for general rules in the use of this treatment. More specific details will be given in the discussion of the various headings that I have given.

#### METHOD OF CONDUCTING BACTERIAL EXAMINATIONS.

In all cases we use the following media: Agar, glucose-agar, blood serum,

and bouillon; the cultures are made aerobically and anaerobically.

In the case of dentin small bits are smeared over the solid media, and dropped into the liquid media.

In root-canals the dentinal structure is removed by a sterile bur, and the shavings dropped upon or into the media. We begin with a No. 3 bur, then use a No. 4, and so on up to No. 6. After we use a No. 6 bur the sides of the canals are lightly burred with a lower number, as No. 1. Of course in some cases the use of so large a bur as No. 6 is precluded, but the same principle is observed.

The bacterial examination of root-canal contents is made by scraping out the material with a sterile broach, excising the broach with sterile cutting-pliers, and dropping it upon the media. Sterile cotton points are introduced into the canals and then cultured.

#### STERILIZING DISINTEGRATED DENTIN.

(I) *It is effective in sterilizing disintegrated dentin overlying pulps.* In the course of our studies upon the bacteriology of dental caries at this institution we have found that cavities as they are ordinarily prepared for filling are not sterile. If cuts are made into the deep dentinal structure, and the material cultured, a good growth of the Moro-Tissier micro-organisms, which we have elsewhere shown to be the constant flora of caries,\* is obtained. In the account of our work we have shown that this type of bacteria, and this alone, remains alive under fillings for at least six months. They are not only alive, but grow vigorously when cultivated upon laboratory media. With the dentinal tissue, then, containing bacteria, and with the bacteria capable of living under fillings, according to modern surgical principles this tissue should be sterilized even in simple cavities, while in deep cavities it is more imperative.

The study of carious tooth sections

shows that the carious process penetrates much deeper than is ordinarily supposed. Particularly is this so in the molars of children. It is not practical to sterilize by means of the bur cavities that approach closely to the pulp. Is it not infinitely better not to disturb decalcified dentin, with its perfect and individual adaptation to the pulp, than it is to remove it and to attempt its substitution by a foreign material? Such a substitution can at best be only a crude and rough affair. Is not the sterilization of this tissue and its simultaneous impregnation with a metal an infinitely more therapeutic measure?

#### DESIRABILITY OF SAVING THE PULP WHERE POSSIBLE.

One cannot examine carious tooth sections for long without being convinced that the pulp comes early into contact with the bacteria of caries. Cavities in the molars particularly penetrate quickly to the pulp; *to* but not *into* it. The pulp has the ability to protect itself against bacteria as does other tissue, but the pulp has the further ability of recalcifying dentinal tissue. This has been practically shown, but is not yet fully understood, so that unless bacterial contact becomes an invasion, or the vitality of the pulp has become impaired, it seems reasonable to believe that the treatment we are presenting for your trial and study can act only beneficially.

Is it not better in the most extensive decay of molars to apply this treatment and to give the pulp a restorative chance than it is to immediately destroy it? I shall show farther on that the pulp is an important organ until late in life, and every effort should be made to preserve it. This is particularly so in the case of the growing child.

In the case of infection of the pulp, as in the case of many oral infections, the actual bacterial invasion must be preceded by chemical or mechanical trauma, by circulatory disturbance, by the irritations due to thermal changes, or to the conductivity of metallic fillings, by disease, by nervous disturbances, and other

\* *Journ. Med. Research*, n.s. xxxi, No. 3, pp. 481-91.



similar agencies. The pulp has its full share of resistance, and will respond to therapeutic measures. Wash out the cavity with Dakin's solution, then treat by the method that I am giving here, and I think that the pulp will have a fighting chance, and recover its normality if it has not been too severely injured.

If the agitation over the blind abscess amounts to nothing more, it at least demonstrates to us that to save teeth we must begin at the beginning, and conserve dentinal tissue. It is possible to

simultaneously impregnate it with a metal like silver?

#### IMPORTANCE OF PRESERVING THE FIRST MOLARS.

The removal of the four first molars from the children in a clinic of the size of this is a matter that deserves more than passing attention. A good inch taken from each arch and to the depth of half an inch in the grinding region of a child's mouth, directly under and affecting the maxillary sinuses during a growing and formative period, is a serious matter. It is serious directly to the individual, indirectly to posterity. Every dentist recommends coarse foods and mastication for tooth and jaw development and protection; so does the physician for a more extended bodily effect. Shall we reduce the masticatory surface by one-third, and at the beginning of life? We are continually dealing with cramped arches and nasal constrictions. Shall we at one operation reduce the size of the arch in a large measure?

Recall the animal experiments that demonstrate the effect of the use or lack of use of the molars upon the dental arch and the adjacent structures. The deciduous teeth upon one side of the animal's head were removed or treated so that they were not usable, while upon the other side they were not disturbed. After a few weeks the skulls of these dogs showed a striking cessation of development upon the unused side, not only of the teeth, but of the nasal passages and of the sinuses, while upon the other side a full and natural growth took place. Nasal constriction, then, follows removal of these teeth in children, and we know that full nasal breathing is of importance in general health. Statistics show that by far the most frequent tooth to decay is the first molar. For these reasons a more than ordinary attempt should be made to save these teeth, and I feel that the treatment which we have under consideration has possibilities in this direction that are superior to a mere mechanical procedure, whether the caries comes

FIG. 1.

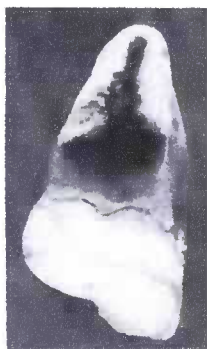


FIG. 2.



These teeth were treated in the mouth and then extracted. The sides were ground off and the penetration of the silver is shown. The healthy tissue is not penetrated, but the unsound structure is.

destroy a tooth mechanically as well as pathologically. It requires some skill to cut out or off any part of the anatomy. But surgery should be the last resort; it should follow only after all restorative attempts have failed. We should rely more upon therapy and less upon mechanics in all dental treatment. Cavities are rarely sterilized by the bur, as we have ascertained by careful clinical and laboratory examination, and our sections show why. It is on account of the depth of the bacterial penetration. This is particularly the case in posterior teeth. Is it not better, then, to remove as little as possible of dentin consistent with the stability of our mechanical substitutes, and sterilize this disintegrated tissue and

to us at its commencement or in a more advanced state. The clinical results are certainly very encouraging.

STERILIZING PUTRESCENT PULPS.

(II) *It is possible to completely sterilize a putrescent pulp without removing it.* We do not recommend this procedure, but by it it is entirely possible to leave a silver deposit in the tissue of the pulp, perhaps in the form of silver albuminate. At any rate, the pulp is

vation and retention of the tooth, is not only rendered sterile, but is impregnated with metallic silver. If this treatment is thoroughly applied no further treatment is necessary, and the tooth may be immediately filled.

TREATING ACUTE PERICEMENTITIS FOLLOWING DEATH OF THE PULP.

(III) *When the death of the pulp is followed by acute pericementitis, it is only necessary to apply the treatment and close the tooth, when the inflama-*

FIG. 3.

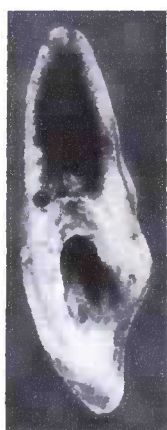


FIG. 4.



FIG. 5.



These are laboratory teeth. The tooth in Fig. 3 had five foramina; that in Fig. 4 had two foramina. All foramina are filled. Note the healthy structure in the root of the tooth in Fig. 5, just above the gum margin.

sterile if the procedure is properly carried out, as we have demonstrated by repeated tests.

This is a safety measure, for it not infrequently happens in root-canal work that, although the instruments are sterile, the septic pulp tissue is pricked through the apices, or that the broach goes through after passing through septic root matter, thus inoculating the tissues beyond.

If upon opening a tooth that is pulpless the first procedure is to apply this method, the canal may be cleaned in safety. Indeed, it is surgically clean and more. The dentinal tissue of the root itself, of equal importance in the preser-

tion will be promptly allayed. It is better to see such a case a second time, for in any inflammation serous exudates occur, and they might find their way into the canal. These should be absorbed with sterile cotton points in the usual way, and the sterilization done a second time, depositing a good body of the silver in order to close the foramina. In such cases as we have had under observation this treatment has apparently ended the trouble. We have found that canals which have been treated by other methods, when treated by the method we are describing are dry, and that the small canals have been closed with the silver.

## TREATING CHRONIC ABSCESS.

(IV) *We have found this treatment effective in chronic abscesses.* In the treatment of these cases we do not hesitate to work the material into the abscess itself by way of the root-canal. At no time have I seen any indication of disturbance following such a procedure, but in all cases the treatment has been markedly effective. As yet we have not had to remove any of the teeth so treated, and they have been the discards of a large clinic. Some of our efforts have not been wholly successful, but a radio-

FIG. 6.



FIG. 7.



Showing it to be possible to use this method in anterior teeth. No discoloration of crowns.

graph has usually disclosed the cause, showing that we were not able to reach the abscess; but in all cases it is safe to say that there has been great improvement. This may be seen from the description of the cases that Dr. Burke has treated, which is included in this report.

In the use of this treatment in chronic abscesses it may be well to use as an adjunct to it some more continuous mode of sterilization. The action under this method is immediate and complete. An abscess, or an inclosed or encysted area responds curatively to ionization. Those preparations that give off formaldehyd or induce some more penetrating or continuous method of sterilization are valuable aids in such cases.

Before this is discussed further, notice from an examination of our slides what occurs in a vital tooth in an inflammatory condition of the pulp or of the pericementum, more frequently in chronic than in acute cases. Usually a so-called acute crisis is the result of a chronic condition. Long-continued irritation of the pulp, even if in a mild form, eventually results in the death of the pulp, and then comes the acute abscess, which when neglected relapses into a chronic abscess. Ground sections of teeth so affected, abscessed or pyorrhetic teeth, show distinct hyaline areas throughout the dentinal structures. This is indicative of degenerative action. In these hyaline areas the dentinal fibrils are few and far between, as shown in the illustrations. This fact, if ever noticed before, has never been enlarged upon. So, too, where pulp irritation has been of long standing the dentin is affected. While this hyaline condition of the dentin is undoubtedly a degenerative process, it is at the same time a protective one, for it stains only where the fibrils exist. Just previous to the actual hyaline state the dentin undergoes an alteration under which it stains deeply. We are extending our studies upon these internal tooth changes, and in another paper shall give a fuller account of them.

If you will examine the teeth that we have treated by this method you will see that the sound tissue is not affected, while the unsound is black with the silver impregnation. Some of these teeth were treated in the mouth and then extracted. The sound tissue seems to be unaffected. (See Figs. 1, 2, and 3.)

In practice we attempt to fill the canals of pulpless teeth—although the X-ray shows that in a large majority of cases we do not—but no or but comparatively little attention is paid to the dentinal structure. These sections show that the alteration is extensive; that the silver fills this affected dentinal structure. Our bacterial examinations show that the tissue is sterile when thus treated. Hyaline areas are sealed by nature, so that we feel we are demonstrating important facts in tooth treatment.



In the ground sections of teeth that we present here deep penetration of the tubuli is seen. A distinction must be made between the laboratory tooth and the living tooth, for the one is not vital, while the other is, and contains normal serum and moisture. It is at times possible to stain a laboratory tooth that apparently is sound, while in all the teeth we have treated and then extracted, the healthy dentin has not been stained.

From what has been said it is evident that in chronic abscesses, so far as the root-canal and dentinal tissue are con-

teria by various solutions, and we may incite a healthy healing process so that shortly the wound becomes bacteria-free. This is about what we are to expect in dental abscess treatment. The forces of immunity and of resistance are fully as much to be considered as the mere presence of the bacteria. I believe that ionization is frequently an excellent accompaniment of this method that I am recommending, for it induces a healthy action in tissue, and reaches farther than we are always able to do with this treatment.

FIG. 8.



FIG. 9.



FIG. 10.



Illustrating the manner in which the solution finds its way to the very end of the root, even when the broach is unable to reach it.

cerned, this treatment is immediate and effective. When worked directly into the abscess nothing but good results have been observed so far as our studies show; but if there is a sac of serous matter it should be drained, washed with Dakin's solution, and resolution awaited before it is finally filled. Some of our investigators have endeavored to show that they cannot get an abscess sac sterile. We should hardly expect to do this clinically at one operation. We have to remember that anything that destroys the bacteria destroys the living tissue. We may wash a wound free from detritus of many kinds, we may reduce the number of bac-

These cases should be kept under observation, and the permanent filling not too hurriedly inserted, not because of the tooth itself, for the affected tooth structure is sterile and impregnated with the silver, but on account of the abscess sac and the peridental membrane, which require a little time for return to normality.

#### TREATING APICAL AREAS.

(V) *Application of this treatment to the region of the apices of tooth roots.* When a pulp is removed under conductive or infiltrative anesthesia no one can say at what point it will be torn off. The

elastic pulp tissue may break short of the apical foramen. There may be several foramina, and several shreds may be left. The break may occur and the elasticity of

the adult a limited hyaline condition very frequently exists in this region. This may be more or less extended without any noticeable pathological features. In the case of the chronic root abscesses there is an extended hyaline area, occurring not alone at the apex of the root but here and there throughout the tooth, although more especially toward the end of the root.

What the X-ray may disclose we are not prepared to say—we have not sufficiently studied this histological change; but the fact that such a change does occur should be borne in mind in interpreting the radiograph. We have seen revealed by radiography failures in attempts to fill root-canals. That these were not filled was not known by the patient or by the operator. In many

FIG. 11.



FIG. 12.



These are sound teeth from patients twenty-two and twenty-five years of age respectively. The dentinal structure is white, opaque, and uniform in appearance.

the tissue draw the point of breakage outside of and beyond the apical foramen. Any of these are annoying conditions, and a source of discomfort to the patient, frequently of long duration. The application of this treatment disposes of the first condition, and is an aid in the second.

From what we may see from the ground sections in the laboratory and from the clinical evidence that we have, the treatment is ideal in any apical work. In the case of the many foramina, they are rendered sterile and are filled. One tooth with five foramina shows the silver in every one. In the case of crooked and of very fine roots the silver goes to the very end, as may be seen in the illustrations. The silver has gone through in some cases, but nothing but good effects have been observed. When penetration does occur it is not similar to the penetration of gutta-percha.

The treatment of root apices is a delicate matter, in my opinion. Examination of the tooth sections that we have prepared will show that in the teeth of

FIG. 13.



Showing a small cervical cavity. By transmitted light the disintegrating effect may be seen reaching to the pulp. A close examination shows a dentinal alteration. The posterior portion of the tooth is affected more or less throughout its length. This may be seen along the upper part of the root. At the apex a distinct hyaline area exists, as with the sound teeth in the previous figures.

such cases the tooth has been useful, comfortable, and physiologically tolerated. On the other hand we have taken out with the fingers loose teeth from about which pus was discharging, and from which an eighth of an inch of



gutta-percha was protruding through the apical end of the root. We have also removed from a fistula a pellet of gutta-percha that had been forced through the root-end. Nature is wonderfully tolerant, but we can see no reason for forcing gutta-percha into tissue beyond the root-end. Such a foreign mass is only an irritant, and disturbs the natural arrangement of vessels, nerves, and tissues; it interferes with the natural circulation. The tooth at its apex is tapered, often translucent, as I have shown by sections,

the return to apparently normal state that follows its use.

#### DESENSITIZING REMAINING PULP SHREDS.

(VI) *Disposes almost painlessly of the remaining part of a pulp after the death or removal of a portion of it.* Another place where this method is serviceable is in the case of a vital pulp shred that remains in one root-canal, while in the others the pulp is dead. These living shreds are difficult to get rid of. By this

FIG. 14.



FIG. 15.



FIG. 16.



FIG. 14. Note the cavity extending to the pulp. Note dentinal alteration, also the hyaline condition at the apex. This tooth had abscessed.

FIGS. 15, 16. These show a similar dentinal alteration. The teeth were firm in the jaw, but were removed with others.

and the adjustment between this and the alveolus is delicate.

When there are several foramina, why should a gutta-percha point forced into the adjacent tissues an eighth of an inch, passing between all these natural connective openings, be considered a therapeutic measure? It is well to keep away from the apical region with mechanics. The treatment that we are advocating has at least some elements that are in harmony with modern biological principles. The enlarged apical ends of the developing molars of the child present no difficulties that cannot be safely remedied by this treatment, if we are to judge from the subsidence of inflammation and

method one is able to almost painlessly dispose of this sensitive pulp tissue. If slight pain is felt when the ammoniacal silver nitrate is applied, follow it immediately with formalin, working it down the root-canal, when the pain will cease. Pressure with a rubber pellet is sometimes a very good way to force the liquid down the canal; the pulp will be sterile and stiff with the impregnation of the silver.

#### USE OF SILVER NITRATE SOLUTION FOLLOWING APICOECTOMY.

(VII) *A still further application of the principle of dentinal tissue impreg-*

nation in the treatment of the tooth stub after apicoectomy. Dr. Shuman, after examining the tooth sections and the effect of this method in other cases, ap-

Previous to its use an occasional swelling would occur some time after the operation.

There are questions that naturally

FIG. 17.



FIG. 18.



FIG. 19.



Fig. 17 shows abscessed tooth in which the crown was broken in grinding. Figs. 18 and 19 show pyorrhetic teeth. Note in Fig. 19 that both the pulp and the pericementum have taken part in this dental change.

plied it following apicoectomy for the purpose of sterilizing the remaining den-

arise in the consideration of this method, some of which we shall attempt to answer

FIG. 20.



FIG. 21.



FIG. 22.



Showing localized areas where the dentin has become completely hyaline, with no dentinal fibrils to be seen. These areas will not take stain. They are absolutely sealed.

tin and sealing it against serous exudates following the operation, and reports that he has had no trouble since its use.

here. One of the first that occurs is, Does this treatment discolor the teeth? It renders them jet black wherever the

silver deposition takes place. This is certainly an objection to its use, and limits its employment. It will enter any defective tooth structure, but does not seem to penetrate sound tissue, as we have said.

The method was evolved particularly to save posterior teeth, the first molars especially, nearly all of which are affected in a large clinic like the one at this institution. The treatment had to be prompt, simple, and efficacious—and so far it seems very successful. Here the color did not matter so much, but breadth

the laboratory before trying it on the patient.

#### TOLERANCE OF THE TISSUES FOR THE SILVER SOLUTION.

Another question that arises is that of tissue tolerance. It is a well-known fact that silver in its metallic form has been used in different parts of the body, and that it is tolerated by the tissues. We have shown that when it is passed outside of the apical foramen it has not increased inflammation, but allayed it.

FIG. 23.

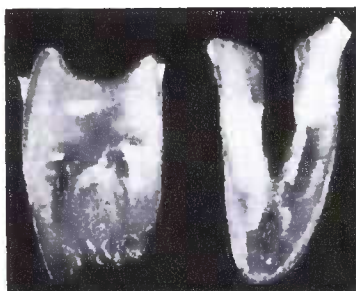


FIG. 24.



Showing abscessed roots of children's sixth-year molars. These teeth were firm, but had a history of swelling, and were inflamed at the time of extraction.

of application was needed, and we have therefore worked out the following method for treatment of anterior teeth. The root-canal is enlarged to well below the gum margin. The entire tooth is coated with adhesive wax, and the enlarged part of the canal is filled with it. With a cold wet instrument the wax is punctured in a line with the apical end of the root-canal. The canal is cleaned with a barbed broach and the silver solutions applied. After treatment the apical portion of the root is filled by any method chosen, any remaining silver being wiped out, and the wax removed. This prevents discoloration of the lower part of the canal or the crown. It is best to practice this procedure in

We have in our collection a molar that is dark with silver stain throughout its entire root substance! This tooth was firm in its socket, a piece of alveolus being removed with it in its extraction. The tissues around it were pink and healthy. The majority of the remaining teeth were loose and diseased, and for this reason were removed. One occasionally sees a tooth filled with coin amalgam that has outlasted modern work.

Silver nitrate has long been used in dentistry to allay sensitiveness and to arrest decay. It has been used electrolytically in abscess treatment. Dr. Prinz's book contains an excellent exposition of the subject. Silver tartrate and silver citrate have been recommended for



wound treatment. Dilute silver nitrate is used for an eyewash for infants. Argyrol is of wide use. It is reasonable to conclude that silver is not only tolerated by the tissues, but that it is a valuable therapeutic agent. In presenting this method of sterilizing and at the same time impregnating affected dentinal tissue, we wish to state that we still consider the work experimental. Whether it is original or not is a matter of no moment. So far as we know it is, and we believe it is founded on sound principles. If it is ever good practice to sterilize and fill tooth tissue it may be done in this manner simply, effectively, and perfectly.

We do not hesitate to recommend it for trial. It is natural to expect some failures, particularly until the technique is mastered. In the hands of the dental practitioner this will be readily accomplished, and undoubtedly many helpful suggestions will be made.

If there is anything to be added in the way of caution in the employment of this method, it is to remember the distinction between dentinal tissue and the cellular tissue beyond the root-end. While the silver does no harm in the diseased cellular tissue, and is indeed beneficial, it is at times slightly irritating for a short period. On the whole, we believe that it is the best practice to first use Dakin's solution in this tissue, and confine the action of the silver solution to the dentinal tissue as much as possible. Should this not prove effective, work the silver solution directly into the abscessed tissue. No serous discharge ever follows. The tooth is always dry, and it is sterile. A little experience and a little judgment is all that is necessary.

#### Preliminary Report of Cases.

The following is a preliminary report of cases by Dr. Burke. He has many other cases he has treated, which he will make the subject of a subsequent report. Many more are being daily treated in this manner by other operators in our

clinic, an account of which will be given later.

*Case 1.* Lower right first molar. Pulp had died under an amalgam filling. There was considerable pain and some swelling, the X-ray showing an abscessed area at the apices of the roots. (See A.)

Ammoniacal silver nitrate and formalin was applied in the canals, and cultures taken from the canals, which showed no growth. The



A



B

Case 1.

tooth was then sealed up with cotton and gutta-percha. The X-ray showed a deposit of metallic silver along the walls of the canals and the pulp chamber. (See B.)

The treatment was repeated one week later: there had been no pain after the first sitting, and the swelling was reduced.

*Case 2.* Lower right first molar. Patient eleven years of age. X-ray taken before treatment, June 8, 1917. (See A.)

The mesial canals were putrescent; the pulp in the distal canal was vital, with a history of pain. Ammoniacal silver nitrate in solution was introduced into the canals, pumped

down with a smooth broach, and reduced with formalin. The tooth was sealed with gutta-percha.

On June 22d, patient returned for further treatment. There had been no pain or odor. The treatment was repeated.

On June 29th an X-ray (see B) was made before filling the canals, showing deposit of

*Case 3.* Upper right first bicuspid—X-ray taken before treatment (see A)—containing a putrescent pulp, with a very foul odor.

One or two drops of the silver nitrate solution were applied in the pulp chamber of the



A



B



C

Case 2.

metallic silver along the walls of the canal and the pulp chamber. The canals were filled with zinc oxid, aristol, and eugenol solution, plus gutta-percha points.

On July 6th an X-ray (see C) showed the canals filled.



A



B



C

Case 3.

tooth, and gently worked into the canals with a smooth broach. One drop of a 25 per cent. solution of formalin was then added to reduce the silver nitrate.

A radiograph (B) shows the deposit of the metallic silver along the walls of the pulp chamber and root-canals.

Cultures taken from the dentin of the canals showed no growth.

A radiograph (C) shows the canals filled.

*Case 4.* Lower right first molar, in which an attempt had been made to remove the pulp with novocain at some previous time. I found the mesial canals putrescent and the pulp in the distal canal vital.

Silver nitrate was introduced into the canals by applying a drop or two in the pulp chamber and then working it into the canals with a smooth broach. This solution was reduced in the tooth by adding one drop of a 25 per cent. formalin solution.

The canals were then filled with a paste of zinc oxid, aristol, and eugenol, and gutta-percha points.

*Case 5.* A lower left second molar in which the pulp had died under an old copper amalgam filling. There was the usual foul odor accompanying such a condition.

The solution of silver nitrate was introduced into the canals, and reduced with the solution of formalin, and the tooth sealed with sterile cotton and gutta-percha.

*Case 6.* Lower left first molar of a patient twelve years of age. A radiograph (see A)



A



B

Case 6.

shows the case before treatment, June 2, 1917. There was present a putrescent pulp with a history of pain and swelling.

An ammoniacal solution of silver nitrate was introduced into the canal, pumped down

with a smooth broach, and reduced with a 25 per cent. solution of formalin.

The tooth was sealed with cotton and gutta-percha. A radiograph taken June 9th (see B) shows the deposit of the metallic silver along the walls of the canals and pulp chamber. Cultures taken from the canals were negative.

The canals were filled with a paste of zinc oxid, eugenol, and aristol, plus gutta-percha points.

*Case 7.* A lower right first molar which had previously been treated with phenol and formocresol, etc., but finally presented with a slightly foul odor.

Silver nitrate and formalin were applied in the canals and cultures taken were negative. They were immediately filled with zinc oxid, aristol, and eugenol paste, plus gutta-percha points, with no subsequent trouble.

*Case 8.* Upper left first molar which had abscessed and was loose and aching, with considerable swelling.

Silver nitrate and formalin were applied. The tooth was so sore that it was impossible to apply the rubber dam. The patient returned the next day, when the swelling was still present, though no pain accompanied it.

The tooth was again treated with formalin and silver nitrate and sealed up with cotton and gutta-percha. The patient presented herself three days later, at which time the swelling was completely reduced and there was no pain; tooth firm.

The tooth was examined two months later. The gum about the tooth was pink and healthy, the tooth firm, and there had been no pain or discomfort since the treatment.

*Case 9.* A lower right first molar which had been long treated and was very uncomfortable to the patient. Examination showed hypertrophied pulp tissue filling all the canals. Ammoniacal silver nitrate solution was gently worked into the canals and reduced with formalin. As the hour was late, a filling of zinc oxid and eugenol was inserted, and patient seen on the following morning. No vital pulp in any of the canals; tooth dry and sterile. This tooth was then filled in the usual manner, with no subsequent trouble.

*Case 10.* A lower left first molar with vital pulp left in the root tips after attempted removal under conductive anesthesia. This tooth had been a source of discomfort to the patient for three months. The tooth was treated according to the method described and filled at once, with no further trouble.

10 EXETER ST.