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Towards a More Rational Technique for the Treatment of Root Canals

DR. OSCAR A. MAISTO

To attempt to give a clear and precise outline of root canal treatment in a few brief pages, would be a difficult and probably vain task.

The treatment of penetrating caries and their complications is such a complex problem, and the various methods and drugs applied so numerous, and even contradictory, that the general practitioner is often baffled as to what therapeutic means should be utilized in each case.

Research workers and specialists, anxious to find an entirely satisfactory solution, conceive and adopt difficult technical procedures that can only be applied to a very limited number of circumstances. Moreover, these procedures are often inaccessible to the average dentist, and too expensive for most patients; these however, are usually unwilling to have their own teeth replaced by prosthesis, which are not always efficient and often damage the neighboring teeth that lend them support.

Notwithstanding the fact that constant progress in medicine will not allow for the establishment of definite procedures, root canal therapy has developed in such a way that it can be expected that in the near future, by means of more rational and biological basis, a certain proportion of the devitalized teeth of our patients may be spared, without becoming a menace to their health.

We will begin by dealing with the problem of pupal semiology, at the time of operation, as a guide to the best procedure to adopt. The fact that certain stages of pulp disease show no clinical evidence is often used as an excuse for discarding useful data that may be gathered from a careful examination of the pulp. Let us definitely discard the empirical classification of caries by "degrees," and remember that they are either "enamel" or "dentinal." When pulpal physiology becomes involved we come within pulpal pathology. Pulpal disease may exist in absence of caries, just in the same way as the latter does not affect the pulp when checked in time.

Turning to the aim of conservative therapy, let us not forget that were we to insert creosote or camphorated phenol dressing in a tooth affected by ulcerative pulpitis that is not very troublesome, we are liable to transform an open pulpitis—in which the underlying pulp manages to defend itself beneath the necrotic focus—into a practically closed pulpitis—ever so much more serious and painful. The same dressing in a tooth with abscessed pulpitis that is extremely painful not only will not succeed, but will most likely induce subsequent necrosis and gangrene of the pulp, as we will have annuled the only possible chance of the abscess opening into the carious cavity, which would have given relief. In the first instance—that of an exposed pulp—a thorough chemo-surgical cleansing of the cavity should have been followed by a total pulpectomy with the help of an anaesthetic. In the case of an abscessed pulpitis that is usually extremely painful, we must attempt to make an ample opening of the pulp chamber and apply an antiseptic dressing during 48 hours; this will be followed by total pulpectomy under anaesthesia.

The dentist can easily determine by means of the diagnostic elements at his disposal, whether the morbid pulpal process has followed the stages of an acute inflammation—hyperemia to necrosis, without a direct chamber connection with the cavity of the caries; or whether, the condition is that of a chronic period of pulpal disease, with an ulcerated pulp directly in contact

with the cavity of the caries in the absence of clinical symptoms. Let it be remembered that thermometric and electrical diagnosis can only tell us whether the pulp retains its vitality or not, but never determine the depth of the infection.

The highest value of an exact diagnosis of the pulp at the time of operating lies in the possibility of being able to ascertain whether coronary pulpectomy may bé performed successfully. It must not be forgotten that the pulp tissue that remains infection-free, allows for the perfect repair of the periapical zone so long as it is not hampered by irritating antiseptics that are not tolerated by the living cell. That is why partial pulpectomy, leaving living radicular pulp protected by a slightly antiseptic paste that is well tolerated, is the ideal treatment for incipient pulpitis. Although we have not obtained better results from ionophoresis of the remaining pulp, we hope that penicillin and sulphonamides will act conjointly upon the living tissue and thus annul the possibility of a residual infection.

If the infection is limited to the actual pulp, and does not affect the periapical zone nor the dentine lining of the radicular apex, the apical complex should not be injured by surgical trauma nor irritant antiseptics. In such cases, the filling of canals short of the apical foramen, generally condemned, are the most perfect and often allow calcification of the apex and the formation of osteo-cement.

In practice the problem is more complex as there is no way of determining the exact extent of the pulp infection, neither is the microbiological control of the canal walls reliable. Therefore, it is essential to rely on slightly antiseptic fillings that will be tolerated by the periapical tissues, taking special precautions that non-absorbable substances do not reach the foramen.

It is generally convenient in such cases that the root canals be filled or the living radicular pulp protected immediately after pulpectomy. Sterilization of the chamber and root canal and its immediate filling with antiseptic paste will undoubtedly produce a certain amount of chemical trauma of the periapical zone that, added to the surgical trauma caused by pulpectomy will naturally produce post-operative periodontitis. This periapical defence mobilization and the small aseptic haematoma that may appear when the anaesthetic vasoconstriction effect has ceased will have no subsequent effects on the future of the tooth, so long as there is no infection and the filling is well tolerated by the living tissues.

When pulpal infection has gone very deep and the pulp is partially or totally degenerated, the problem of tooth preservation becomes most difficult. The lack of organic defence within the root canal due to the absence of living pulp, makes it essential to eliminate every trace of infection. This is extremely difficult owing to the complex anatomy of the root, especially at the apex, as it is frequently impossible to introduce antiseptics where fine instruments are unable to reach, and in face of the possibility of the antiseptics damaging the living periapical tissues that should take care of repair.

Periapical lesions are the logical sequence to root canal infection and, owing to it being impossible to resist the process by means of living tissues within the canal, a periapical granuloma develops as an early form of defence. It also represents a point of diminished resistance and chronic infection, subject to periodical acute manifestations and the possibility of distant disorders, typical of focal infection.

Although it is granted that the periapical tissues might succeed in isolating or closing the periapical foramina while the infection lasts in the canal, it is usually necessary to annul the infection so that, by removing the cause, the granuloma may heal through the formation of fibrous tissues and osteocement. There are certain cases in which the periapical pathological process does not cicatrize, notwithstanding the canal infection having been completely removed. This is due to an intensive necrosis of the apex or the surrounding bone or, in last instance, to the chronic periapical process having

become an organized lesion, characterized by a more independent existence that enables it to continue its development notwithstanding the elimination of the causative factor.

The removal of septic matter and the sterilization of the root canal must be performed with the greatest of care so as to avoid disseminating germs beyond the periapical defensive zone. It is also necessary to avoid damaging the living tissues, either by chemical or surgical trauma so as not to delay their reparative action.

The old technical procedures pretended to rapidly transform the contents of the root canal by an intensive chemical antiseptic, left in situ during a long period, which could attack the living cells also, causing irreparable periapical damage. The surgical and rational present day method tends to direct treatment along a completely different avenue. Faced with the problem of eliminating infection from the radicular canal, so as to aid the periapical lesion towards healing if already infected, it is an indispensable principle to make the canal accessible. Although medical ionization (iodine and Cibazol) and the action of certain volatile antiseptics of low surface tension can reach parts that are inaccessible to small instruments, the surest way of eliminating the infection *is to reach it directly*.

Surgical technique is based on the following principles: the elimination of all septic contents from the canal, canal widening, so as to allow for correct filling, and its sterilization by physico-chemical agents. Accessibility to the apical foramen should not be attempted until the coronary two-thirds of the canal have been curettaged and sterilized. In narrow and curved canals, such as those of molars, only sufficient enlargement should be attempted as is necessary to allow for the filling of the whole canal. Otherwise one runs the risk of losing accessibility to the apical foramen, or of making a false road in the root apex. All caustic agents used to facilitate curettage of the canal walls and to destroy remaining organic substances, should be removed by careful washing. Heating of the antiseptic within the canal by means of a diathermic needle, or by area-fulguration with high frequency currents, avoiding excessive temperatures, are effective means of combating infection. Electrolysis with an aqueous solution of iodine (positive pole within the canal), is also an effective measure.

In cases where the periapical lesion is visible radiographically, surgical action should not be limited to the root canal only. On passing through the main apical foramen with the file, it should be used as an electrode so as to coagulate a small quantity of the neighboring tissues—the zone of greatest infection. Coagulation of the whole of the granuloma when there is a clear definition, could be extremely useful in accelerating repair, but so far there is no means of controlling *how far* the coagulation of live tissue will extend, incurring grave risk of destroying the periodontium and sound bone.

Iontophoresis with an aqueous solution of iodine and using continuous low frequency current, is easily applied and improves defence, while it also aids in sterilization of the apical and periapical complexes.

Residual infection in the midst of live tissue beyond the apex is of little consequence after treatment. When infection has been eliminated from the canal and the periapical defences are alive, the pathological process develops towards cicatrization. That is why, contrary to what is usually held, the size of a granuloma or an abscess is of little value in determining whether it will heal, or require apicoectomy instead of conservative therapy. Extensive lesions that demand a considerable surgical elimination of tissue often heal by conservative therapy applied through the canal, just as quickly as smaller lesions. On the other hand, the smaller and well defined lesions, or where reabsorption of the apex has taken place, are the most suitable for direct surgical treatment.

The final stage of the treatment of teeth affected by necrotic pulp and periapical complications consists in the filling of the

radicular canal. The best filling is that adapted to each case, according to its peculiar root anatomy, the condition of the canals and periapical zone after the treatment. The coronary two-thirds of the canal, the best prepared and sterilized part as a result of the treatment, may be filled with a slightly antiseptic paste of persistent action. In most cases there is no technical procedure that will allow for the use of non-reabsorbable substances in the neighborhood of the foramen, without going beyond it. The only alternative is to cover the foramen with a reabsorbable paste (iodoform, glycerine, chlorine) that will secure the elimination of any possible residual infection. That is why microbiological control of the canal—always uncertain—has no practical value in this procedure. When the apical foramina are wide, the covering should be done with iodoform and surgical sulphonamide, as this last substance has a definite bacteriostatic action in living tissues.

The gutta-percha cones are used to complete the canal filling, taking every precaution that they do not reach as far as the foramen, as they are very badly tolerated by live tissues. The silver cones are valuable in the filling of narrow and curved canals of back teeth; but, notwithstanding their being well tolerated by periapical tissue, it has not been possible to ascertain whether the oligodynamic action of silver is effective within the canal or beyond the foramen. Non-absorbable pastes, stronger in antiseptic action, should only be used where it was not possible to reach the apical foramen, and when it is absolutely certain that filling will not reach the periapical tissues.

Finally, penicillin, used in cases of accessibility, is a valuable means of combating infection. In our first cases we were able to fill the canal and cover it over with a paste of surgical sulphonamide and penicillin. This was perfectly tolerated by the periapical tissues.

The day we are able to completely annul infection of the apical complex, the problem of canal filling in the treatment of penetrating caries and their complications will have disappeared.

Arenales 1999, Buenos Aires, Argentina

(Teachers of Endodontic procedures in the United States insist that it is entirely possible to prepare and fill root canals to the apex without undue periapical disturbance. The bacteriological control method is advised as a means of determining the best type of medication and the time of filling for each patient.—Ed.)

ENDODONTIC ABSTRACTS

N. Westerholn, Finska Tandläkar Förhandlingar, 86:17 (No. 2), Sept. 30, 1946.

The author treated 34 cases of infected pulpless teeth, with or without periapical osteitis, by means of sulfathiazole, cibazole and streptolysin. Of these, sulfathiazole was found to be the most effective. "The question whether these preparations will be able to compete, in the long run, with such chemicals as formerly used in the treatment of root canals, or with more modern preparations, e.g., penicillin, still remains unsolved."

L. I. G.

(Removal of metal fragments from root canals with a spot-welder.) Fuhrer, G., Schweiz. Monatschr. f. Zhk., "Entfernung von Metallfragmenten aus Wurzelkanälen durch elektrisches Mikroschweizzverfahren."

The author has developed a new technic for removing broken instruments from root canals. Instead of attempting to grasp the fragment with an instrument and remove it, a broach is inserted alongside the fragment and an attempt is made to weld the broach to the fragment. The broach is then removed, carrying the welded fragment along with it.

L. I. G.

Surgical Extraction of Roots and Root Canal Therapy and Apicoectomy. Exner, G. G., J. D. Asso. So. Africa, 2:137, April, 1947.

In discussing healing following the removal of impacted 3rd molars or ectopic teeth (those lying outside the dental arch, e.g., in the sigmoid arch, orbit, etc.), the author states that in an average case it takes about 18 months to 2 years for complete bone "regeneration" of the operated wound. Is this approximately the same length of time required for complete bone repair following root canal treatment?

L. I. G.

The Effectiveness of Clinical Treatment of Pulp-Involved Teeth as Determined by Bacteriological Methods

F. D. OSTRANDER, D.D.S., M.S.,
AND
MARY C. CROWLEY, M.S.,

In spite of the fact that extensive work has been reported establishing the necessity for bacteriological controls in the treatment of pulp involved teeth, one still occasionally hears the use of such controls labeled as impractical in general practice because of the time consumed. In an effort to further establish exactly what may be expected when bacteriological methods are used to control the treatment of root canal and periapical infections, a group of some 800 case histories of pulp involved teeth were recently analyzed. These were cases which had been treated in the undergraduate clinic of the University of Michigan, School of Dentistry, and included all types of cases.

While the primary purpose of the study was to establish the necessity for bacteriological controls and to determine the clinical effectiveness of drug treatments when so controlled, data were obtained and are presented in this paper on several other topics of interest to the endodontist.

FREQUENCY OF PULP INVOLVEMENTS IN INDIVIDUAL TEETH

At the University of Michigan, School of Dentistry, both anterior and posterior teeth are treated and the students are required to distribute their cases fairly evenly between anteriors, bicuspids and molars. Thus the record of the teeth handled in the Endodontia Department should be a reasonably accurate index to the frequency of individual tooth involvements. Table 1 shows the teeth in the order of frequency of pulp involvements.

It will be noted that with the exception of the molars the maxillary teeth are the most frequently involved, 527 or 62.3% of the teeth treated being maxillary while 319 or 33.7% of the cases were mandibular. This difference can largely be accounted for by the relative infrequency of involvements of the mandibular anteriors. However, it is obvious from these data that no tooth is immune to pulp involvements and if the endodontist is to provide the maximum service to his patients he must be prepared to treat all teeth with the exception of third molars and teeth where there are morphological, pathological or systemic contraindications.

TABLE 1

DISTRIBUTION OF PULP INVOLVEMENTS IN MAXILLARY AND MANDIBULAR TEETH

Tooth	*Number Treated*
Mandib. 1st Molar	121
Max. Central	107
Max. 2nd Bicuspid	107
Max. Lateral	105
Max. 1st Bicuspid	81
Max. 1st Molar	75
Mandib. 2nd Bicuspid	73
Mandib. 2nd Molar	47
Mandib. 1st Bicuspid	37
Max. Cuspid	32
Max. 2nd Molar	20
Mandib. Central	15
Mandib. Cuspid	15
Mandib. Lateral	11

ETIOLOGY OF PULP INVOLVEMENTS

An attempt was made to determine the cause of pulp involvement in every root canal case treated. Obviously this was not always possible but in a majority of cases information as to the etiology of the pulp involvement was available. It will be noted in Table 2 that by far the greater proportion of the pulp involvements was due to carious exposures, 606 cases or 80.4% of those for which etiology was available falling into this group. Other causes of pulp

involvement in the order of their importance were found to be trauma, deep silicate fillings, pulp exposure due to instrumentation, thermal shock and traumatic occlusion. The fact that over 80% of the pulp involvements in this series were due to neglected caries again lends emphasis to the necessity for more educational work among the laity as to the necessity for frequent dental examinations. To the dentist it should suggest the value of more extensive use of bite-wing x-rays for diagnosis of early caries.

It will be noted that 44 cases of pulp involvement were found under deep silicate fillings but there obviously was no way of determining whether these involvements were due to residual infection from deep caries or from irritation from the filling. However it was found that the deep silicate cases were 65% infected as compared with 59.6% among the whole group of cases studied (Table 4) and only 47.5% of infected cases among those in which trauma was the etiologic factor. While the irritating qualities of silicates seem well established these figures would seem to suggest that more than just irritation is involved in pulp deaths beneath silicate fillings.

NECESSITY FOR BACTERIOLOGICAL CONTROLS

Although the practice has long been abandoned in the University of Michigan dental clinic, it is still occasionally advocated that vital exposures which have not been painful should be filled at the same sitting at which the pulp is extirpated.

TABLE 2

ETIOLOGY OF PULP INVOLVEMENTS

Etiology	Number of Cases	Per Cent
Carious Exposure	606	80.4
Trauma	68	9.0
Deep Silicate	44	5.8
Exposure through Instrumentation	18	2.3
Thermal Shock	13	1.7
Traumatic Occlusion	5	0.6

With this in mind a comparison was made of the bacteriology and treatments required in three groups of pulp-involved cases as follows: 1) those with no history of pain; 2) those giving a history of mild pain; 3) those giving a history of severe pain. The data are shown in Table 3.

It will be noted that there are slightly more infected cases among those patients who gave a history of mild pain than among those who had no pain, and that there were still more cases of infection among those giving a history of severe pain. Also a slightly greater percentage of those cases which had been painful required more than one treatment for sterilization. These results are what could be expected from ordinary clinical observations, but the important point is that even among these cases in which no pain had occurred, 49.9% were infected. Even after a 48-hour drug treatment over 27% of these cases still remained infected and nearly 10% were still infected after two 48-hour treatments. These figures emphasize the necessity for

TABLE 3

RELATIONSHIP OF BACTERIOLOGY AND TREATMENTS TO PAIN PRECEDING PULPECTOMY

History	No Growth		Growth		No. Treatments Before First Negative Culture in Infected Cases									
					One		Two		Three		Four		Five	
	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent	No. Cases	Per Cent
No Pain	144	50.1	143	49.9	104	72.7	26	18.1	7	4.9	4	2.7	2	1.4
Mild Pain	96	47.5	106	52.5	69	65.1	23	21.7	10	9.4	1	0.9	3	2.7
Severe Pain	64	44.7	79	55.3	51	64.5	17	21.5	8	10.1	3	3.7		

bacteriological cultures and inadequacy of merely washing out a tooth with an antiseptic at the time of pulp extirpation, even though the tooth has not been painful. Furthermore these data reemphasize the findings of Grossman (1), MacPhee (2) and other investigators who have found the obtaining of negative cultures to be the only method by which a dentist can be certain that he is not sealing pathogenic organisms into a tooth and periapical area when he fills a root canal.

TYPES OF ORGANISMS ISOLATED FROM ROOT CANALS

In the University of Michigan Dental Clinic every root canal case which is filled must first have two successive negative bacteriological cultures taken at 48-hour intervals. These cultures are taken in situ under a strictly aseptic technic as described by Sommer and Crowley (3). These cultures are incubated, identified and reports prepared in the bacteriology department. Since the types of organisms which are predominantly responsible for root canal and periapical infections is a matter of great interest to the endodontist, an analysis was made of the bacteriological findings from first cultures in a group of 859 cases. The data obtained are presented in Table 4.

TABLE 4

FINDINGS FROM FIRST BACTERIOLOGICAL CULTURES IN ROOT CANAL CASES

	No. Cases	No. Cases	Per Cent
No Growth	.....	347	40.4*
Growth	.....	512	59.6*
Variety of Organisms	107	.....	20.9†
Combination of Organisms	90	.....	17.6†
Streptococcus anhemolyticus	94	.....	18.3†
Streptococcus viridans	74	.....	14.4†
Streptococcus hemolyticus	12	.....	2.3†
Anerobic streptococci	6	.....	1.1†
Bacillus acidophilus	11	.....	2.1†
Actinomycetes-like organisms	3	.....	0.1†
Contaminations	115	.....	22.4†
Total	512		

* Per cent of total cases in this group.
† Per cent of cases showing growth on first cultures.

An extremely important fact to be noted in Table 4 is that 40.4% of the 859 cases studied were not infected. This is not only of academic interest, but important to the man in practice in that these cases can be filled after two treatments which include cultures, thus conserving valuable time which would have been wasted in unnecessary treatments without cultures.

Cultures in which the organisms were identified as spore formers, *Staphylococcus albus*, yeasts, etc., were considered to be contaminating organisms rather than true infective agents since they occur so frequently as contaminents in bacteriological cultures. Approximately one-fifth of the cases showing growth on the first culture fell into this group since many of them were carious exposures, had been open to the saliva and therefore most any type of organism presumably might be found in the cultures. If we eliminate the 115 cases in which the possibility of contamination could not be eliminated we have remaining a group of 397 cases of pulp or periapical infections. Of these 107 were reported as "Variety of organisms." When 3 or 4 types of organisms were present, the culture was classified as a "variety of organisms." Another 90 cultures showed combinations of organisms in which streptococci were present in 85 of the 90 cases and among the cases showing pure cultures streptococci were present in 186 of 200 cases. To summarize, out of 290 infected cases in which the organisms were definitely identified, streptococci were found to be present in 271 or 93.4% of the cases. Since streptococci were seen in practically all of the cultures reported as "variety of organisms" it is presumed that these would follow approximately the same proportion. It will be noted (Table 4) that *Streptococcus anhemolyticus* and *Streptococcus viridans* account for the vast majority of the infecting organisms isolated from the teeth and that *Streptococcus hemolyticus* occurs only infrequently.

It should be emphasized that the streptococci are not necessarily the only organisms acting as etiological agents in pulp and periapical infections. However it is known that they are capable of producing lesions

in other parts of the body, e.g., *Streptococcus viridans* is the most frequent cause of subacute bacterial endocarditis. This knowledge, plus the fact that streptococci are isolated in some 90% of the cultures of infected teeth seems adequate basis on which to assign the streptococci a predominant role in the etiology of pulp and periapical infections. It should be pointed out that adequate culture methods are necessary to ascertain the types of organisms present.

PERIAPICAL PATHOLOGY AND BACTERIOLOGY

There is still far too great a tendency among dentists to consider every tooth with radiographic evidences of periapical pathology to be infected. That this is far from the truth is clearly demonstrated by Table 5 which compares the first cultures of 487 normal periodontal membrane cases with 119 cases with periapical pathology. While 61.3% of the cases with pathology were infected as compared with 52.3% of the normal periodontal membrane cases, it is significant that even when pathology was present 38.6% of the cases cultured showed no infection present. In short, no dentist nor physician has any right to tell a patient that a tooth is infected simply because an x-ray shows periapical pathology unless he has first demonstrated infection with a bacteriological culture.

INCOMPLETELY FILLED ROOT CANALS AND BACTERIOLOGY

In the past some investigators have stated that nearly 100% of all devital teeth are infected teeth and some have gone as far as to say the same for vital teeth having cavities. Most of this earlier work was based on data obtained from the culturing of extracted teeth. More recent work by Fish and MacLean (4), Tunnicliff and Hammond (5), O'Kell and Elliott (6), Grossman (7) and Appleton (8) have shown the unreliability of such cultures.

In this series of cases 35 were found in which the root canals previously had been incompletely filled. In many of the instances no pathology was evident radiographically

TABLE 5

PERIAPICAL PATHOLOGY AND BACTERIOLOGY

X-RAY DIAGNOSIS	BACTERIOLOGY			
	No Growth		Growth	
	No. Cases	Per Cent	No. Cases	Per Cent
Cases with normal periodontal membrane.....	232	47.6	255	52.3
Cases with periapical pathology.....	46	38.6	73	61.3

but it was felt necessary to refill the canal because of the possibility of future trouble. Twenty-four of the 35 cases or 64.8% showed no growth when cultured. The fact that only 35.2% of these poorly filled root canals showed the presence of infection obviously supports the more recent studies which show that by no means all of this type of teeth are infected and that the poorly filled root canal can not be considered a potential etiological factor in systemic disease unless it is proven to be infected by bacteriological methods.

EFFECTIVENESS OF DRUG TREATMENTS

A question of paramount importance to the practicing dentist is, "How much time is a bacteriologically controlled treatment plan for root canal cases going to require?" In fact some dentists have hesitated to adopt bacteriological controls for root canal work because they have felt that the time factor would prove prohibitive. Actually the time required for taking a culture, incubating it and determining the presence or absence of growth is negligible. The actual taking of the culture will require about one minute. Small incubators for growing the cultures are again on the market at a reasonable cost and sterile culture media ready for use is available from hospitals or commercial concerns such as the Difco Laboratories of Detroit. The average root canal case does not require identification of the organism present and whether or not there is infection in the tooth can be determined by simply looking at the

culture tube after it has been incubated for 48 hours at 37° C. A clear tube indicates no growth while a cloudy tube indicates the presence of infection. Thus bacteriological controls of root canal treatments are simple, can be handled in any office and are not time consuming.

In order to determine exactly what may be expected as to the number of treatments required to obtain two negative cultures, a series of cases which had been treated routinely in the clinic was studied and as a control another series treated in the author's private practice was tabulated. The standard drug treatment used on both these series of cases consisted of thorough washing of the canals with solution of sodium hypochlorite U.S.P. or its equivalent followed by a 48-hour drug treatment sealed into the tooth under a double seal of temporary stopping and cement. The drug most frequently sealed into the tooth was camphorated paramonochlorophenol but some cases were treated with Chloroazodin U.S.P. (Azochloramide) and for experimental reasons some of the clinic series were treated with eugenol and formaldehyde-cresol solution. The results obtained in 759 cases treated in the clinic are shown in Table 6 and Table 7 shows the results in 138 cases treated in the private practice.

TABLE 6

TREATMENTS REQUIRED TO OBTAIN TWO SUCCESSIVE NEGATIVE CULTURES IN 759 ROOT CANAL CASES TREATED IN THE DENTAL CLINIC AT THE UNIVERSITY OF MICHIGAN, SCHOOL OF DENTISTRY.

No. of Treatments	Cases Completed	Per Cent
Two	298	39.3
Three	281	37.0
Four	83	10.9
Five	47	6.2
Six	33	4.3
Seven	10	1.3
Seven Plus	7	0.9
Total	759	

Average Number Treatments per Case—3.06.

It will be noted that in the clinic series, 39.3% of the cases required only two treatments, while in another 37% of them two

TABLE 7

TREATMENTS REQUIRED TO OBTAIN TWO SUCCESSIVE NEGATIVE CULTURES IN 138 ROOT CANAL CASES TREATED IN PRIVATE PRACTICE.

No. of Treatments	Cases Completed	Per Cent
Two	36	26.1
Three	51	36.9
Four	28	20.3
Five	11	7.0
Six	7	5.1
Seven	4	2.9
Nine	1	0.9
Total	138	

Average Number Treatments per Case—3.41

negative cultures were obtained at the end of three treatments. In short over 76% of the cases were filled after three treatments. Since it has been the observation of the authors that most of those dentists who do not control their root canal work with cultures, treat their cases three or more times, it appears that culturing root canals may actually be a time-saving, rather than a time-consuming operation. The average number of treatments per case for the clinic series was 3.06 while the average for those treated in private practice was 3.41, a rather close correlation for the two series of cases.

On the basis of clinical observation it sometimes appears that one or another group of bacteria is more difficult to destroy than another. In an effort to determine what differences might be expected, a group of "pure culture" cases was analyzed and the data is presented in Table 8.

TABLE 8

AVERAGE NUMBER OF TREATMENTS REQUIRED TO OBTAIN TWO NEGATIVE CULTURES IN DIFFERENT BACTERIAL GROUPS

	Strep. anhemolyticus	*Strep. viridans*	*Strep. hemolyticus*
Cases	78	64	11
Total number of treatments	277	217	15
Average per Case	3.55	3.39	3.36

While it will be noted that the average number of treatments required to obtain

Camphorated paramonochlorophenol

two negative cultures in *Streptococcus anhemolyticus* infections was slightly greater than for *Streptococcus viridans* or *Streptococcus hemolyticus*, the difference is not great enough to be statistically significant not to indicate that *Streptococcus anhemolyticus* infections cannot be successfully treated. Individual resistant strains will be encountered in any bacterial group but in general successful results may be anticipated regardless of what infecting organism is present.

RELATIVE EFFICIENCY OF VARIOUS ROOT CANAL ANTISEPTICS

For many years there was a great tendency to use highly caustic germicides in the treatment of root canals. Foolige (9), Grossman (10) and others have cautioned against the use of caustic agents in the treatment of root canals because of the danger of irritation and periapical tissue damage and the possibility that the drug will coagulate organic material at the apex and prevent further penetration. Those in charge of endodontia at the University of Michigan, School of Dentistry, are entirely in agreement with this viewpoint and a caustic drug is rarely used unless the case is one which is to be resected and therefore will not be harmed by a small amount of periapical tissue damage.

In an effort to determine the relative efficiency of some caustic and non-irritating root canal antiseptics, a series of cases was treated with eugenol, camphorated paramonochlorophenol and formaldehyde-cresol solution. These three drugs were chosen for the following reasons: 1) Eugenol is a relatively non-irritating drug with a mild degree of antiseptic value which is used primarily as a rest treatment because of its anesthetizing power. 2) Camphorated p. monochlorophenol is a drug with high antiseptic value but with practically no irritating qualities. 3) Formaldehyde-cresol solution is known to have a high germicidal value "in vitro," but is a coagulant for albuminous material and highly irritating. The results are presented in Table 9

It will be noted that the comparison of effectiveness was made on the basis of the number of cases becoming sterile after one treatment. This was done primarily because the number of cases remaining infected after the first treatment was too small to be considered statistically significant. It will be noted that both camphorated p. monochlorophenol and eugenol proved more effective than formaldehyde-cresol which is a highly irritating preparation.

TABLE 9
COMPARATIVE EFFECTIVENESS OF DRUGS IN INFECTED ROOT CANAL CASES OF ALL TYPES. FIRST TREATMENT ONLY.

Drug Used	No. of Cases Treated	No. of Cases Sterilized	Per Cent of Effectiveness
Eugenol.....	145	100	68.9
C.P.M. Chl. Phenol....	125	93	74.4
Formaldehyde-Cresol...	43	27	62.7

Further extensive work on the relative effectiveness of root canal antiseptics has been carried out and will be reported in another paper. However, the non-irritating camphorated p. monochlorophenol has been found uniformly to be as effective, or in most instances more effective, than the highly caustic agents. Therefore the authors see no reason for the use of caustic root canal antiseptics with their attendant danger to the periapical tissues.

CONCLUSIONS

It is felt that the findings recorded in this study support several important conclusions in the field of endodontia as follows:

1) Approximately 80% of pulp involvements originate from dental caries and could be prevented by more frequent dental visits and the more extensive use of bite wing x-rays.

2) The predominating infecting organisms found in root canals are the streptococci with the order of importance being, a) *Streptococcus anhemolyticus*, b) *Streptococcus viridans*, c) *Streptococcus hemolyticus*. The latter organisms account for only a very small proportion of the infections.

3) Bacteriological cultures are essential under all conditions in endodontia if one is to avoid the filling of infected cases.

4) The average number of treatments required to obtain two negative cultures when root canal cases are bacteriologically controlled is from 3 to 3.5. Therefore the time element which is often advanced as a reason for failure to culture is not valid.

5) Non-irritating antiseptics can be used with equal or greater effectiveness than the more caustic agents.

BIBLIOGRAPHY

(1) **Grossman, Louis I.,** Probable Percentage of Correct Guesses Regarding Sterility of Root Canals Without Bacteriological Control. J. Dent. Res., 15:364, Sept., 1936.
(2) **MacPhee, G. Graham,** The Problem of the Pulpless Tooth. Brit. Dent. Jour., 6:119, Feb., 1936.
(3) **Sommer, Ralph F., and Crowley, Mary,** Bacteriological Verification of Roentgenographic Findings in Pulp Involved Teeth. J.A.D.A., 27:723, May, 1940.
(4) **Fish, E. Wilfred, and MacLean, I.,** The Distribution of Oral Streptococci in the Tissues. Brit. Dent. Jour., 61:336, Sept., 1936.
(5) **Tunnicliff, Ruth, and Hammond, Carolyn.** Presence of Bacteria in Pulps of Intact Teeth. J.A.D.A., 24:1663, Oct., 1937.
(6) **Okell, C. C., and Elliott, S. D.,** Bacteremia and Oral Sepsis. Lancet, 869, Oct. 10, 1935.
(7) **Grossman, Louis I.,** Root Canal Therapy, 2nd Ed., Lea and Febiger, Philadelphia, 1946. Chapt. 10.
(8) **Appleton, J. L. T.,** The Bacteriologist Looks into the Patient's Mouth. J.A.D.A., 27:171, Feb., 1940.
(9) **Coolidge, E. D.,** Studies of Germicides for Treatment of Root Canals, J.A.D.A., 16:698, 1929.
(10) Reference No. 7, Chapt. 14.

University of Michigan, School of Dentistry

Why Not More Endodontia?

CHARLES M. WHITE, D.D.S.,

If a poll were to be taken of the number of dentists who are doing root canal work in each community, the percentage would still be very small. One hears arguments in favor of the procedure from many of the older men and from a few of the younger men recently graduated from dental school. There seems, however, to be a group of dentists in the 30 to 50 age group who have what seem to them valid arguments against this important phase of dental service. Everyone has a reason for or against any operation in dentistry. Let us examine the reasons against treatment.

1. Root Treatment Results are Too Uncertain.—Reason number one may be true. Results are also uncertain in treatment of a host of other diseases of the body such as: anemia, tuberculosis, nephritis, heart disease, and many others. The human body usually resists treatment to a certain degree, and favorable results in any part of the body can not always be promised. Patients must be informed of the hazards before work is started, and in a few words or by a simple drawing on a note pad tell just why it is impossible to guarantee results.

In talking with a physician friend of mine a few years ago, I said to him, "Doctor, if you make calls on one of your ill patients for two weeks and at the end of that period the patient dies, do you get paid for the calls?" He, of course, said, "Surely, why not?" My answer rather ironically was that since the efforts ended in failure, that the value simply wasn't there, so why should folks be asked to pay for something that ended in failure. His reply again was, that physicians get paid for their efforts, not for results; and said that if physicians didn't get paid for trying, they wouldn't try. I then remarked that in dentistry we have difficulty getting paid for failures.

That, it seems, is one of the biggest reasons why dentists shy away from root canal work. It is probably a reason too why one-third of the people 50 years of age

and over in this country are wearing full dentures. Dentists were not willing or able to gamble their own time and money trying to save their patients' health and appearance. It would seem to be much more fair to ask the patient what his wishes are in the matter. Maybe the patient is willing to gamble some of his money to try to save his teeth. At least he should have the chance.

2. Root Canal Work Consumes Too Much Time.—This idea springs from the old idea where strong drugs were sealed in the pulp chamber on Monday, the patient told to return Thursday, at which time the "nose test" was used and another treatment placed, the patient told to return possibly a week later.

Along about Sunday evening when the dentist would be enjoying the *New York Times* together with his pipe, bath robe and slippers in front of a cozy fireplace, the telephone would ring. The patient on the line in extreme pain would be the one with the "embalming" treatment in the upper left lateral. A trip down to the office, and the treatment removed gave relief. Then the following week the same episode was probably repeated. Finally, patient and dentist both gave up and the tooth was removed. Yes, that kind of root treatment was certainly time-consuming and still is. Ionization and modern improved methods of sterilization of root canals is the answer to objection Number Two.

3. So-Called Dead Teeth are a Threat to the Patient's Health.—That objection is not so easily answered as the first two, but it's true that the highest authorities in dental research are not now so sure that bodily ailments are cured in wholesale lots by the removal of pulpless teeth. In fact, many are now deciding that the tooth with the well filled canal is the safest tooth in the mouth. No chance for a degenerative pulp there, if it has been properly cared for.

The question as to whether a pulpless tooth is a menace to health will, no doubt, remain unsolved for many hundreds of years. In fact, it may never be answered. It was my privilege a few years ago to have as a patient one of our last surviving Civil War veterans. He died at the young and tender age of 93. About four or five years before that, I removed the last of his pulpless teeth. I might add that the root canal work in this case was far from perfect, and not in the least comparable with what we are doing today.

Would the 100 percenters have had my 93-year-old veteran made toothless at the time he was made a prisoner at Libby prison in order for him to attain a ripe old age? He enjoyed many a nourishing meal with his own teeth after he had helped Grant take Richmond.

It's sad but true, no doubt, our great, great, grandchildren will have professional advice both medical and dental for the removal of pulpless teeth to cure their ailments; often the procedure will seem to have effected a cure, more often not. So let's not feel too badly if we cannot settle objection Number Three here and now.

4. Teeth With No Pulp are Liable to Turn Dark in Color.—Again that statement is true, but it is not difficult to avoid if proper precautions are taken. And even if every anterior treated tooth were to turn dark, we can always resort to the use of a porcelain jacket. Many anterior teeth from which it is necessary to remove pulps need porcelain jackets anyway. Many of them have been supporting large gold inlays or synthetic porcelain fillings and need jackets even without pulp removal. Many older people with teeth too white and even, are thought to be wearing artificial dentures. A certain degree of variance in color and form is usually desirable. As to the molars and bicuspids being darkened by root treatment, their size and form precludes this hazard.

We must conclude then that for the 20 posterior teeth the problem of discoloration is not a serious one, and for the 12 anterior teeth porcelain jackets may be used. One hears often of the statement, "I treat the 6 anterior teeth but no posteriors." Where do men get the idea that only the 6 upper

anteriors are important? Certainly from the health standpoint, the posteriors are the more important to retain. Very often the rubber dam is more easily applied to posterior teeth than to anteriors and the canals are often more accessible. From an orthodontic standpoint, the posteriors are much more important to retain than upper anteriors as in cases where the lower first molar is lost. Every dentist is familiar with the resultant drifting and tipping. The end result can be a closed bite and a chain of events leading to full dentures early in life.

It is evident, then, that the four main arguments against root treatment can be answered without too much difficulty. Instead of being influenced too much by precedent, half truths, and hearsay, many dentists will decide to do a little of their own thinking. It is even possible that very soon more dentists will be making life more livable for more people through endodontia.

350 N. Park Avenue, Warren, Ohio

Use of Sodium and Potassium in Root Canal Therapy

MILTON J. WAAS, D.D.S.,

It is a curious phenomenon in these days of World Wars and atom bombs that so many Endodontists have acquired a fear complex. They seem to be afraid of the very occasional infinitesemal spark or the almost inaudible "fff-sst" sound reaction resultant from the use of Sodium and Potassium in root canal therapy. I also find from different sources that many teachers of endodontia are removing it from their procedures because they feel it to be "a dangerous drug." It does require a bit of precise instruction, but so do most dental procedures. The proper preparation of a cavity for gold foil, gold inlay, amalgam and porcelain inlay also require a bit of instruction. A bit more perhaps.

In 1892 at the Columbia World Fair, Dr. Emil Schrier came over from Austria and gave the first American Clinic on the use of metallic sodium and potassium alloy. This he described as an agent to "Mummify" the pulp canal content. But Dr. M. L. Rhein corrected this misapprehension by pointing out that here at last was the perfect method of removing a non-vital pulp.

Sodium and potassium combined with the aqueous content of the pulp changing the entire matter present into sodium and potassium hydroxide. These are saponifying agents easily washed out with hydrogen peroxide or water.

There are also other advantages. Every dentist can remember the little experiment in the chemistry class where water was set on fire by placing some metallic sodium or potassium on the surface. This is exactly what happens to the content of a root canal when using Na and K. There is a great affinity between water and Na and K. The metallic reagent tracks down the slightest evidence of moisture. Even though the user is not aware of it he will succeed in opening any multiple accessory apical foramenae present and also any branching side foramenae present. With proper technic these can be and are filled with ease.

Dr. Rhein had thousands of Roentgenograms showing proof of this statement and many of his followers using this method can also show many such films. I personally have no knowledge of any other technic which can so consistently show this.

Furthermore, as the drug is a metallic paste and used only in the most minute particles at each application it is impossible to have the material run through the apical foramen and destroy a large amount of periapical tissue. If it self-limiti ng in its action.

235 S. Fifteenth St., Philadelphia 2, Pa.

Program of the Fifth Meeting

OF THE

American Association of Endodontists

Congress Hotel, Chicago

FEBRUARY 7 and 8, 1948

Saturday, February 7

(Pine Room)

6:30 P. M.—Dinner and Business Meeting.

Sunday, February 8

(Florentine Room)

General Session on Medical and Basic Science

10:00–11:00 A. M.—"Dermatological Lesions of Interest to Dentistry," by Dr. Maurice T. Fliegelman, Department of Dermatology and Syphilology, University Hospital, Ann Arbor, Michigan.

In addition to his duties in the Medical School, Doctor Fliegelman is a regular lecturer to the graduate and post-graduate classes at the W. K. Kellogg Foundation Institute and appeared on the program of the 1947 Annual Meeting of the Michigan State Dental Society. He will present Kodachrome slides of many of the dermatological lesions which occur in and about the mouth and face, and will discuss their significance to the practicing dentist.

11:00–12:00 A. M. "The Bacteriology of Endodontia," by Mary C. Crowley, M.S., University of Michigan, School of Dentistry.

Miss Crowley has had many years of experience in the handling of the bacteriological problems which arise in endodontia practice. She was largely responsible for the development of the bacteriological methods now taught in the undergraduate and graduate endodontia clinics at the University of Michigan and speaks with authority on the subject assigned to her.

Sunday, February 8

(Florentine Room)

General Session on Research in Endodontia

1:30–2:00 P. M. "Benzylog—A New Drug and Its Clinical Application," by Dr. Gerard J. Casey, Loyola University, School of Dentistry.

Doctor Casey is Assistant Professor of Therapeutics at the School of Dentistry, Loyola University and with his associates has been conducting extensive research on a new drug which shows promise of usefulness as a root canal antiseptic. His findings should be of great interest to the Endodontia Association.

2:00–2:15 P. M. "Preliminary Report on Indium as a Root Canal Filling Material," by Dr. H. H. Pierson, Montreal, Canada.

Doctor Pierson is President of the Montreal Endodontia Society and will report on the experimental use of a new material for root canal fillings.

2:15–2:45 P. M. "Treatment of Infected Pulpless Teeth with Penicillin," by Dr. Louis I. Grossman.

Dr. Grossman requires no introduction to the American Association of Endodontists. He will report on the experimental use of penicillin in high concentrations for the treatment of root canal and periapical infections.

2:45–3:00 P. M. Intermission.

Sunday, February 8

(Florentine Room)

General Session on Endodontia Technique

3:00–4:00 P. M. "A Survey of Different Techniques Employed in the Treatment of Various Types of Infected Pulpless Teeth," by Dr. E. Alan Lieban, New York, N. Y.

Dr. Lieban is Post-Graduate Instructor in Endodontia for the First District Dental Society, New York City, Hudson County Dental Society, Jersey City, N. J., Greater New York Dental Meeting and the Dental Corps, U. S. N. He will review the treatments he has used in the management of various types of infected pulpless teeth and results obtained over a period of 25 years will be presented.

4:00–4:40 P. M. "The Indirect Resection," by Dr. George Hare, University of Toronto, School of Dentistry, Toronto, Ontario.

Doctor Hare has recently been given the responsibility for the teaching of endodontia at the School of Dentistry at the University of Toronto. He will report on the indirect resection, a procedure for the preservation of the pulp-involved anterior tooth without marring an existing jacket crown or post-restoration. A moving picture of the operation will be presented.

4:40–5:15 P. M. "The Mechanism of Periapical Infections and Their Therapy," by Dr. Samuel Turkenkopf, Newark, N. J.

Doctor Turkenkopf is a member of the Root Canal Division, Beth Isreal Hospital, Newark, N. J.

Endodontic Abstracts

Clinical Trials of Treating Infected Pulps With Penicillin. Munz, F. R. Dent. Record, 67:115, May, 1947.

The author treated 56 teeth with penicillin. Of this number there were 8 cases of pulp necrosis (all anterior) and 48 cases of infected pulps (both anterior and posterior teeth). In such cases where inflammation of the apical region was present, it was possible to eliminate it in a short time. In these cases, about 160–250 units of penicillin were used.

Of the 48 cases where the pulps were exposed by caries or were accidentally exposed, there were 24 successful cases in the sense that there were 14 cases both clinically and roentgenologically negative and 10 cases which were clinically comfortable for at least 10 months afterward but the patients could not return for x-ray check-up. The author went to extremes, however, in his efforts to save the pulps in these cases, the average number of treatments in the successful cases being 7. In the other 24 cases, failure resulted.

The author is aware that the number of cases in this series is small and that the pulps should also have been examined histologically, but suggests this as a possible method of pulp conservation. He points out that "the most promising and important factor in these clinical trials is that they show that the infected and exposed pulp has the same power of resistance and ability of repair as any other tissue."

L. I. G.

M Pohto, Finska Tandläkar Förhandlingar, 87:33 (No. 3), Dec. 15, 1946.

Ten human teeth with inflamed pulps—acute serous or chronic "open" pulpitis—were treated with penicillin (100,000 units per cc. of physiologic salt solution). The age of the patients varied from 17 to 35 years. The penicillin solution was applied to the exposed pulp and sealed at the first visit. At the next visit, a paste for the purpose of protecting against reinfection was sealed against the pulp. The paste consisted of sulfathiazole, calcium glycerophosphate and vigantol (a vitamin preparation).

The treated teeth were removed after 43 to 100 days. In 7 of the 10 cases, microscopic examination showed repair of the pulp by granulation tissue. Odontoblasts were replaced by scar tissue, not by new odontoblasts.

L. I. G.