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ROCANAL Root Canal Therapy

By Dr. Edgar J. Corneo-Lobenstein

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A BIOTECHNICAL SYSTEM PART I

Biology and Biotechnique

**Problems related to current
methods**

Biotechnical Programming

**The Difference between
Pulpectomy of Vital Pulp and
Extirpation of Necrotic
Content**

Irrigation

Permanent Filling

Conclusion

According to N. Ripp(1) the best root canal filling material is the vital pulp. No doubt that the healthy pulp is ideal from the biological point of view. However, it is also true that if the pulp is ill and infected, it can be considered the worst canal filling.

It is obvious that between these two standards, there is a therapeutical possibility, even better, a therapeutical necessity.

The purpose of therapeutical intervention is not to restore the biological ideal, but to reach the position of compromise which permits functionality without subsequent pathological consequences.

BIOLOGY AND BIOTECHNIQUE

The root canal treatment must be done with the aid of technological means. They have to be efficient and conceived in a manner to avoid negative consequences, although they are not biological in the literal sense of the word. This is the field of "biotechnology".

What does it mean? First of all, it means that we must not consider what has been planned by the dictates of "ideal" biology, since they are unattainable.

We shouldn't run the experimental tests based on ideal biological reaction, because the reaction differs from our intentions and possibilities. On the contrary, we have to program our therapeutical intervention in such a way to reach the desired final clinical result.

As a practical example, it is known that Eugenol cement is an excellent root canal filler (2,4). This is due to its adhesion to the walls (3) and to the presence before setting, of Eugenol. But the biological "tests" proved that Eugenol is toxic for cell cultures such as fibroblasts (4). Based on these results, one is lead to believe that the use of Eugenol should be avoided since it appears to be antibiological. However Eugenol is also a useful and powerful disinfectant: its phenol coefficient is 9.7 (5).

Upon the final setting of the cement, this action diminishes considerably and this explains the minimum irritability and the excellent tolerability in the zone of periodontium at the apex (6).

Furthermore Eugenol diffuses by imbibitions, so it reaches zones which have not been instrumented and cleaned.

D. Orstavik (24) affirms that *there are few data to indicate that superior biocompatibility is essential for endodontic treatment success.*

Endodontic problem cases are usually successfully treated when anti-infective measures have been effective. Significant improvement in endodontic therapy may be expected when control on infection can be achieved regularly and predictably. Possibly, insertion of materials with a controlled release of an antibiotic, disinfectant, or pharmacologically active substance may be advantageous.

So, ideal biological requirements give place to clinically proved final result. It is just what is expected to be and it can be obtained by bio-technical programming.

PROBLEMS RELATED TO CURRENT METHODS

Current methods may be resumed on the triad proposed by Naidorf in 1974 (7): Instrumentation – Sterilization – Obturation.

Many efforts have been made to improve these procedures in accordance with biological ideals.

For these reasons, the term sterilization has been changed in "disinfection". It is given more importance to a thorough cleaning and shaping of the complete root canal system rather to the chemical disinfection (26).

The filling material of choice is gutta-percha, considered an inert material. Orstavik (24) gives more details: *Permanent obturation after cleansing, shaping, irrigation and medication.*

The same author states that *the infectious nature of apical periodontitis and of many of the failures after endodontic therapy makes it likely that the antibacterial aspects of treatment will remain important in the future (16). He also states that Bacteria-associated endodontic failures together with pulpo-periapical infections refractory to conventional treatment represent the unresolved bacteriological problems in endodontics (16).*

The antibacterial aspect cannot solve completely the problems: the root canal is not just some kind of "tube" which can be cleaned, irrigated, dried and then sealed hermetically. Instead it is a capillary system which can be cleaned only in its main parts.

There will always be micro remnants of the pulp, left in zones not touched by our chemo-mechanical intervention.

The presence of smear layer (formed during mechanical preparation of the dentine walls) certainly does not help in attaining an aseptic situation since it includes organic substances and bacteria.

Considering the problem under a pure biological aspect Spangberg (1982) (8) has demonstrated that antibacterial activity is always accompanied by cytotoxicity.

Limiting the action to the extemporary disinfection seems to be improper. The action is time-limited and, soon after it has exhausted itself, bacteria are present again (13).

The irrigation with sodium hypochlorite seems also to be improper. Its hemolytic action has been demonstrated even at a dilution of 1:1000 (28) and serious complications in its therapeutic use are well known (28,29).

As a matter of fact, the search for an "ideal" disinfectant is still on, as well as that of a perfect cleansing solution...which practically does not exist.

Wollard et Al (1976) (9) documented that none of the methods for obturation of the root canal space with gutta-percha was efficient.

Munaco et Al. (1978) (10), Moller et Al. (1984) (11), showed that gutta-percha remains highly toxic. Elmiger (1979) (12), demonstrated that the

perfectionistic obturation methods (three-dimensional vertical condensation of heated gutta-percha) did not give complete filling in narrow canals.

The presence of periodontal "buttons" of gutta-percha, consequence of condensation pressure, is not ideal.

In effect, gutta-percha, or more precisely, the mixture of gutta-percha, zinc-oxide and other additives, if placed beyond the apex in the periodontium, is not inert at all.

It is not resorbable, it will always irritate and may provoke a reactive chronic inflammation as well as an acute one.

Since gutta-percha has no function in the canal (not even that of sealing), it is necessary to use a cement which will close the coronal and apical zones of the canal and dentine tubuli.

The efficacy of endodontic cement is diminished because the cement itself is reduced to a minimum quantity.

Generally, it is known today that the majority of pathogenic bacteria are anaerobes (14,15). Therefore, the ideal place for their growth is a canal sealed by an inert material or by one that does not act against anaerobes. Sooner or later there will be a secondary infection (13).

According to Orstavik (20) infection is the dominating cause of apical periodontitis and probably of failures after endodontic treatment.

To day antibacterial properties of endodontic materials are a controversial issue, whereas relative non-toxicity and/or bone-growth stimulating activity is considered desirable by most clinicians and researchers (20).

In the past, some practitioners believed in "magic" properties due to particular pharmacologically active substances (19), permitting simplified operative procedures ("mummification").

In Europe there have been two attempts to solve the biological pulpar problem: partial fixation of pulpar wound with paraformaldehyde (21) and biopulpotomy of vital pulp (22). Unfortunately the results were not the expected ones. The fault was in the vain belief that with that therapy the pulpar remnants could undergo its own cicatrical transformation and eventually calcification.

The treatment and final filling of the root canal has to be reconsidered.

BIOTECHNICAL PROGRAMMING

Bio-technical programming is based on two requirements focussed in the canal treatment: eliminate the possibility of autolysis and heterolysis.

Gravenmate (17) has written: in the enclosed pulpal space, toxic compounds are formed by the action of extracellular enzymes from microorganism and by the autolysis of proteins from pulpal tissues. Endodontic intervention should strive to remove both processes. Any remaining tissue should also be mummified, or fixed, as it is called in chemical terms. By definition, such fixation also leads to disinfection. Since disinfection does not necessarily lead to fixation, this point of view contrasts with current therapy that is primarily focused on the disinfection of the contents of root canal.

Also J.C. Hess (18) states that the therapeutical aspect in root canal treatment must follow two lines:

- 1) the microbicidal,
- 2) the anti-catabolic action of enzymatic lysis.

All these aspects have conducted us to consider the root canal treatment not on the basis of pure biological concepts, but giving more emphasis to the bio-technical means.

They have conducted us to distinguish the canal treatment of vital teeth from the treatment of gangrenous canals.

The reason is that in the first the autholytic processes are the main problem, while in the second one, the heterolytic action of bacteria has to be more considered.

THE DIFFERENCE BETWEEN PULPECTOMY OF VITAL PULP AND EXTIRPATION OF NECROTIC CONTENT

The distinction between vital pulp and gangrenous canal content must be considered because the treatment is different since the bacterial situation is different. It is possible that in the vital pulp bacteria are absent or present only because brought in during intervention.

In necrotic canals instead, the intervention needs particular pharmacological treatment, as well as operating precautions, in order to avoid the transport of germs in the periapical zone. The bacterial flora is different: especially anaerobes and fungi.

During the treatment of silent, chronic forms, periapical flare-up may occur, because the work performed in the course of mechanical cleansing of the canal, may cause an unintentional inoculation in the periodontium more easily.

It is possible to prevent or at least to reduce these reactions if, immediately upon the preparation an antibiotic-antiinflammatory based medicament is applied in the periodontium by passing through the canal with a syringe. We have been using since long a dermatological cream, neomycin-cortisone based (not perfumed, not greasy and not radioopaque). Just a small amount is sufficient.

The intervention is not obligatory, but, often it helps.

Sometimes, in difficult situations, it can be repeated after a day or two. The final filling will be effected when the periodontal symptomatology ceases, i.e., when the "danger" is over.

But, the canal must be prepared first: it is cleaned and the meantime disinfected in the same first sitting, to the apex. For this purpose we use a lubricant with a disinfecting action, based on povidone-iodine, a iodoform, mixed with a water-soluble substance. It is an ideal medicament because it is visible during the application, it acts on a large antibacterial spectrum and even in the presence of pus or blood (see table 1). When the preparation of the canal is finished, the lubricant can be easily removed with a simple washing.

If it is unintentionally brought over the apex, it does not cause pain and it is not dangerous if it gets to patient's tongue or if it is accidentally swallowed.

Water-soluble povidone-iodine is quite an efficient antiseptic for preparation of the canal prior to permanent filling.

An antiseptic must act immediately and must not be left in the canal for long period of time as medication with the intention to obtain a prolonged nontoxic disinfection. Any disinfectant is toxic, otherwise it would not work.

Consequently, the less it stays in the canal, the better it is. Povidone-iodine can be used as temporary medication between sittings, before permanent filling, by placing a paper-cone saturated with it. But, as soon as the "danger-period" of a flare-up has ceased, it is suggested to close permanently the canal. In the case of a gangrenous pulp, no medicamentous treatment beyond the apex is recommended (like iodoform or calcium hydroxide), only the anti-inflammatory cream, as described.

IRRIGATION

In our practice the use of toxic and dangerous irrigating substances (such as sodium hypochlorite) has been eliminated for a long period of time. Also the use of hydrogen peroxide (perhydrol) has been abandoned because of its haemolytic action. The foam which it develops comes out of the canal, goes in a coronal direction, but also beyond the apex, causing small hemolysis with subsequent post-operative pain. It has also been abandoned because of its poor cleansing and antiseptic actions.

The only irrigation is carried out at the end of the preparation before the permanent filling.

The liquid used is an hydro-alcoholic solution of quaternary ammonium base (Hyamine 622), a surface-active cationic agent. It is bactericidal even in minimum concentration, deodorizes and is highly detergent (see Table 2). It also dries easily because it is a hydro-alcoholic solution and there is no need for hard drying with hot air, which, if performed for a long time, could cause emphysematous reactions.

Believing that the irrigation eliminates completely all organic substances and the smear-layer is concept which does not take into consideration the real anatomic situation of root canals (27).

PERMANENT FILLING

The filling of the root canal, the final part of our intervention, has been programmed in a way to act where the cleansing-disinfection did not arrive. The filling is obtained using exclusively cements and not other materials, like gutta-percha.

We have distinguished the closing of the canal after vital pulpectomy and the closing which follows the treatment of gangrenous tooth.

As we have already explained the grounds are different: in one we have more to consider autolytic processes, in the second the heterolytic. For these reasons the cements used are two.

The first cement, used to fill pulpectomized teeth, is based on the pharmacodynamic aid of Orthophenylphenol (OPP).

The addition of OPP must not "evoke" the spectre of dangerous, toxic substances, as some surveys tend to suggest because of the toxicological aspects of certain phenolic compounds.

There are some of them, like OPP, which show very positive data (see Table 3). OPP is used also in the food industry, for conservation of citruses.

It has an inhibitory action on certain enzymes which, under anaerobic conditions can promote the formation of sulphate-reducer bacteria and even the proliferation of formalin-resistant bacteria.

The second cement is used to fill treated gangrenous canals and contains Nitrofurazone and OPP.

The pharmacodynamic functions has two distinct moments: immediately after the introduction in the canal and after the cement setting.

These two cements harden to a gutta-percha like consistency. They showed excellent tolerability (25) and are resorbable beyond the apex but not in the canal.

CONCLUSION

The bio-technical treatment programmed as described above, has given very good results. The clinical documentation is very positive (see clinical cases). It started about 20 years ago.

In the past some teachers have said than it was "more important what has been removed from the canal that what has been put in".

We think that it is fundamental, in root canal treatment, to consider every step as being part of a complete program.

A BIOTECHNICAL SYSTEM PART II

**Danger of Sodium
Hypochlorite irrigation**

**The Canal Disinfection is
obtained by Povidone-Iodine
cream in a water-soluble
medium**

**Materials used in Treatment
of Gangrenous Canals**

**Importance of Tolerance in
Root Canal Treatments**

**Scanning Electron
Microscope**

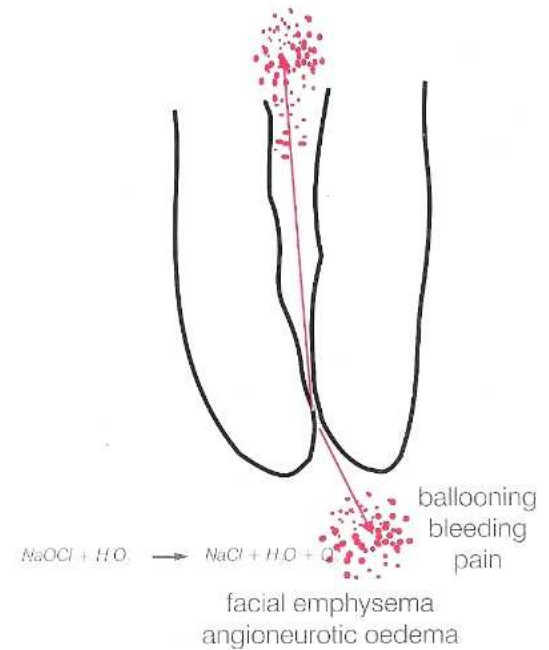
**Table 1: In Vitro Test on
Microbicidal Efficiency of
PVP-Iodine**

**Table 2: Microbiostatic and
Microbicidal Titers of
Hyamine 1622**

**Table 3: Antifungal and
Antibacterial Efficacies of
OPP**

DANGER OF SODIUM HYPOCHLORITE IRRIGATION

Sodium hypochlorite used as canal irrigation is toxic and dangerous, even if it is neutralized with hydrogen peroxide. Hydrogen peroxide is haemolytic. The foam forms not only in external direction, but goes also in the periodontal region. There are many cases described with negative consequences like ballooning, bleeding, periodontal pain, facial emphysema and angioneurotic oedema. With the described "bio-technical" method, this kind of cleansing irrigation solution is abandoned.



THE CANAL DISINFECTION IS OBTAINED BY POVIDONE-IODINE CREAM IN A WATER-SOLUBLE MEDIUM

The properties of this disinfectant are favourable for root canal disinfection and helpful for the mechanical preparation (lubricating action).

Detoxified Iodine: Low animal and phyto-toxicity
Non irritating to skin and mucous membranes
No sensitizing
Does not delay healing or formation of granulation tissue
No stinging
Lessened hazard if accidentally ingested.

Stable Complex: Absence of general odor
Free iodine not extractable by organic solvents
No loss of iodine by sublimation or volatilization
Rapid action even in presence of organic substances (blood, pus, oil, grease, soap).

MATERIALS USED IN TREATMENT OF GANGRENOUS CANALS

Povidone-Iodine cream for disinfection during preparation. Antibiotic-cortisone cream for anti-inflammatory medication over the apex, introduced with a sterile disposable syringe. This action is obtained already using minimal quantity of the product.



POVIDONE-IODINE CREAM IN A WATER-SOLUBLE MEDIUM

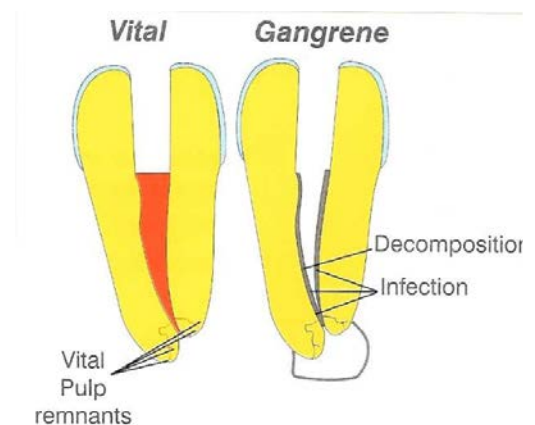
Rocanal Imediat R1

This cream can be used also as intermediary medication (the cream is introduced with a sterile paper-cone). The cream can be left in the canal for one or two weeks.



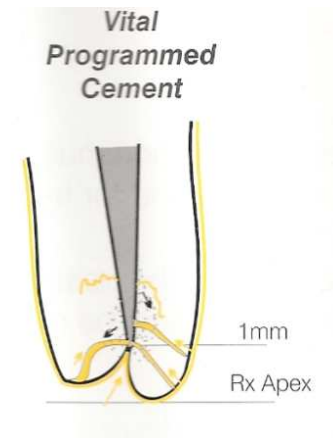
TWO DIFFERENT CEMENTS

Two different cements have been realized to fill the root canal: the first (Rocanal R2) is used after vital pulpectomy, the second (Rocanal R3) after preparation and medication of gangrenous canals. Following biotechnical criteria, the first cement is oriented against autolytic processes, the second against heterolytic processes.



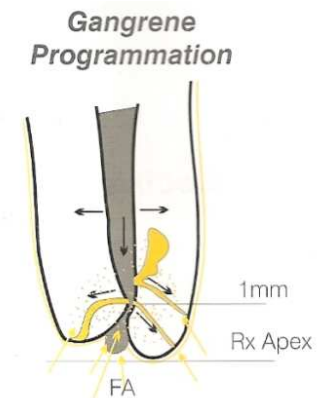
ENDODONTIC CEMENT PROGRAMMED TO FILL THE ROOT CANAL AFTER VITAL PULPECTOMY

The endodontic cement is programmed to be active on pulp remnants remained after complete cleansing of root canal. The cement protects these remnants from autolytic and heterolytic processes. After vital pulpectomy, the filling should reach the apical constriction.



ENDODONTIC CEMENT PROGRAMMED TO FILL THE ROOT CANAL AFTER TREATMENT OF GANGRENE

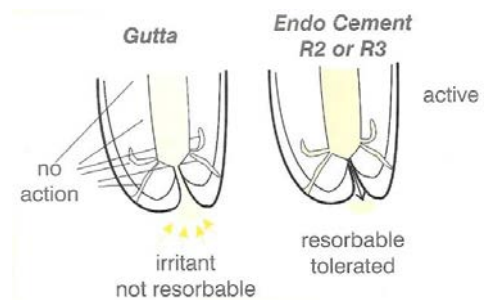
This cement is introduced preferably without gutta-percha. The action is programmed to protect the canal from secondary infection (heterolysis), particularly under anaerobic condition. The intracanal action is particularly active before cement setting.



DIFFERENCE OF FILLING WITH GUTTA-PERCHA AND WITH ENDODONTIC CEMENTS

Gutta-percha is irritant if it goes over the apex and is not resorbable. No active action in the canal.

Endodontic cements are, if programmed with a bio-technical system, active in the canal. They are resorbable if they reach the periodontal region. They are well tolerated if they reach involuntarily the periodontal area. They do not disappear from the canal.



IMPORTANCE OF TOLERANCE IN ROOT CANAL TREATMENTS

Tolerance is synonymous of bio-technical method for treating root canal. First of all it is the treatment method that must be controlled.

Tolerance:

1. Treatment Methods

2. Toxicity: irrigation – disinfection – filling

3. Action: how many – how long

4. Solubility

5. Resorbability

SCANNING ELECTRON MICROSCOPE

Photograph of a root canal filling with Rocanal endodontic cement only.

The filling is well adherent to the canal walls.

It reaches an unprepared "cul de sac"

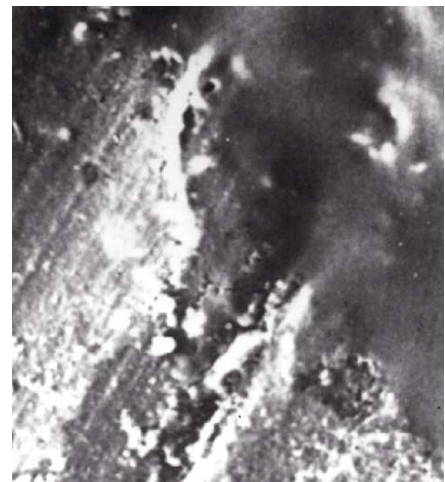


TABLE 1: IN VITRO TEST ON MICROBICIDAL EFFICIENCY OF PVP-IODINE

<p>Micrococcus pyogenes var. aureus (FDA 209 and an antibiotic-resistant stain) Salmonella typhosa (2 stains) Streptococcus hemolyticus (2 strains) Pseudomonas aeruginosa (2 strains)</p>	<p>PVP-Iodine (1% available iodine) in dilutions up to 1 : 10 without and with 10% whole blood or 5% serum killed on contact within 15sec. all bacteria in 4mm loop</p>
<p>Micrococcus pyogenes var. aureus</p>	<p>PVP-Iodine (1% available iodine) sterilized the culture; tincture of iodine beaker contained viable count of 1040 bacteria per ml.</p>
<p>Streptococcus pyogenes Pseudomonas aeruginosa Escherichia coli Micrococcus pyogenes var. aureus Candida albicans Trichophyton mentographytes</p>	<p>PVP-Iodine (1% available iodine) killed organisms faster than other preparations containing nitrofurazone, zinc undecylenate, thiomersal, cetylpyridinium chloride, quaternary ammonium, chlorothymol, and merbromin.</p>
<p>Staphylococcus aureus Streptococcus pyogenes Diplococcus pneumoniae Proteus mirabilis Pseudomonas aeruginosa Bacillus subtilis</p>	<p>PVP-Iodine (1% available iodine) in dilution of 1 : 2 killed on contact within 90sec. approximately 95% of each test organism; in dilution 1 : 10, 60 – 70%</p>
<p>Staphylococcus aureus (FDA 209 and 3 antibiotic-resistant strains) Staphylococcus albus Streptococcus pyogenes (hemolytic and viridans) Diplococcus pneumoniae (types I, II, III, IV, V, VII, VIII and XIV) Neisseria gonorrhoeae Haemophilus vaginalis Candida (Monilia) albicans Trichomonas vaginalis</p>	<p>PVP-Iodine was the only commercial preparation tested that in "recommended use dilution" (1% available iodine diluted 1 : 4) killed all the test organisms within 30sec. It was effective within 90sec. when diluted 1 : 40.</p>

TABLE 2: MICROBIOSTATIC AND MICROBICIDAL TITERS OF HYAMINE 1622

Organism	Dilution of active ingredient	
	Bactericidal	Bacteriostatic
Streptococcus pyogenes C-203	1: 50.000	1: 50.000
Streptococcus viridans	1: 200.000	1: 400.000
Escherichia coli	1: 16.000	1: 16.000
Salmonella gallinarum	1: 32.000	1: 32.000
Salmonella choleraesuis	1: 32.000	1: 32.000
Salmonella typhimurium	1: 16.000	1: 16.000
Salmonella schottmuelleri	1: 8.000	1: 32.000
Pseudomonas aeruginosa PRD-10	1: 8.000	1: 8.000
Lactobacillus casei	1: 50.000	1: 100.000
Shigella sonnei	1: 16.000	1: 32.000
Klebsiella pneumoniae	1: 16.000	1: 16.000
Saccharomyces cerevisiae	1: 100.000	1: 100.000
Pityrosporum ovale	1: 800.000	1: 800.000
Trichophyton interdigitale	1: 20.000	1: 40.000
Monilia albicans	1: 400.000	1: 800.000
Aspergillus niger	1: 400	1: 800
Aspergillus oryzae	1: 800.000	1: 1'600.000
Penicillium notatum	1: 800.000	1: 800.000
Penicillium luteum	1: 400.000	1: 800.000

TABLE 3: ANTIFUNGAL AND ANTIBACTERIAL EFFICACIES OF OPP

Test Organism	% for Inhibition	
Fungi		
Rhizopus nigricans	0.015	- 0.02
Rhizoctonia solani	0.001	- 0.002
Chaetomium globosum (ATCC 6205)	0.0025	- 0.005
Hormiscus gelatinosum	0.005	- 0.01
Aspergillus niger	0.025	- 0.05
Polyporus tulipiferae (F.P.L. No. 517, ATCC 11245)	0.005	- 0.01
Aspergillus flavus (ATCC 9643)	0.005	- 0.01
Lenzites trabea (ATCC 11539)	0.0025	- 0.005
Ceratostomella pilifera	0.005	- 0.01
Trichophyton interdigitale	0.002	- 0.0035
Trichophyton rosaceum	0.0035	- 0.005
Bacteria		
Staphylococcus aureus (ATCC 6538)	0.01	- 0.015
Bacillus subtilis (ATCC 8473)	0.01	- 0.015
Enterobacter aerogenes (ATCC 13048)	0.01	- 0.015
Klebsiella pneumoniae (ATCC 8308)	0.01	- 0.015
Pseudomonas aeruginosa (ATCC 10145)	0.02	- 0.025
Pseudomonas aeruginosa (ATCC 15442)	0.045	- 0.05
Proteus vulgaris (ATCC 881)	0.005	- 0.01
Escherichia coli (ATCC 11229)	0.01	- 0.015
Salmonella choleraesuis (ATCC 10708)	0.01	- 0.015
Phenol Coefficients		
(A.O.A.C. Method, Tested at pH 8 to 11 , 20°C)		
Salmonella typhi (ATCC 6539)	24	
Staphylococcus aureus (ATCC 6538)	20	
Pseudomonas aeruginosa (ATCC 15442)	14	

USER GUIDE

Treatment Principles

Vital Pulpectomy

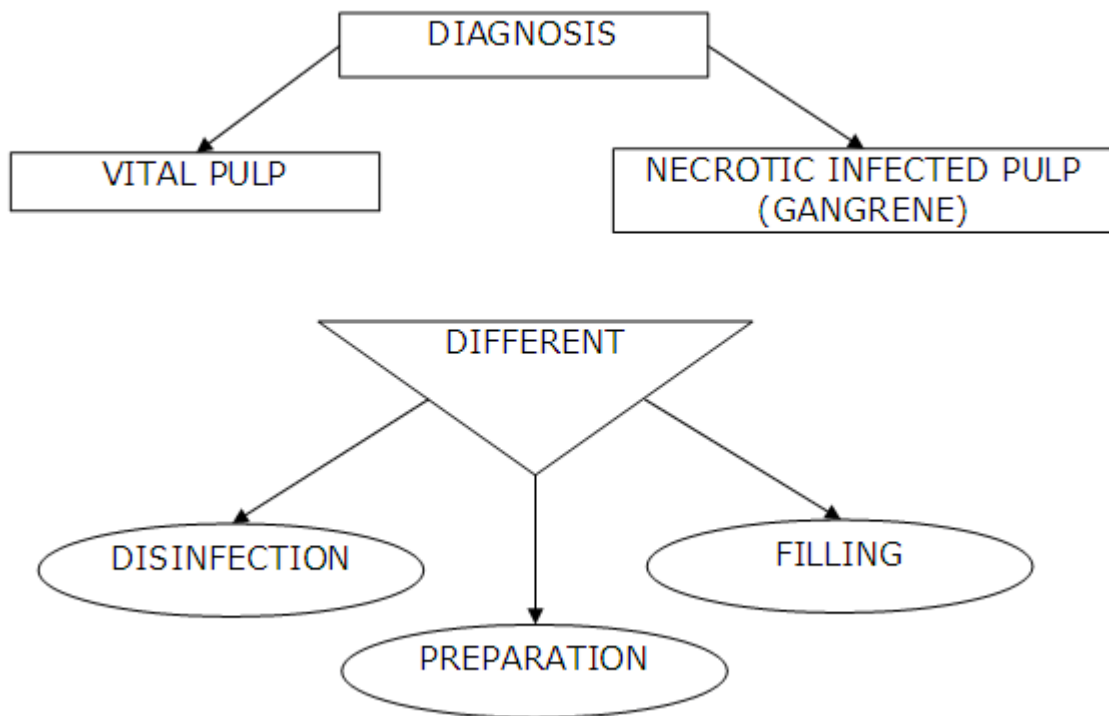
**Vital Pulpectomy in
Multirrooted Teeth**

**Necrotic Infected Pulp
(Gangrene)**

**Multirrooted Teeth
(Gangrenous)**

Pain after Permanent Filling

TREATMENT PRINCIPLES



<p>VITAL PULPECTOMY Products used: Rocanal 1 Rocanal Irrigation Rocanal 2</p>	<p>GANGRENOUS CANAL Products used: Rocanal 1 Rocanal Irrigation Rocanal 3</p>
<p>Temporary dressing only in cases of delay of permanent filling</p>	
	<p>After preparation of gangrenous canal: 1. Placement of antibiotic, anti-inflammatory cream in the periapical region (with a syringe via canal) recommended at the first visit. 2. Temporary dressing in the canal. 3. Permanent canal filling delayed until later visit.</p>

VITAL PULPECTOMY

SINGLE ROOT – NORMAL CANAL (LARGE)

Diagnosis: the pulp is vital (positive reaction to cold-test and electric pulp-tester).

Treatment: the pulp is completely removed from the canal.

Procedures:

X-Ray

Local Anaesthesia:

(test effect of anaesthesia with pulp tester).

Access:

Use round diamond bur to create access to the pulp (the direction of penetration is along the long-axis of the tooth).

First measurement:

Compare length of first instrumentation with x-ray canal length.

Removal of pulp:

Bulky pulp: use rat-tail file with adequate diameter to eliminate bulky pulp.

Movement of file: complete rotation

Normal pulp: rat-tail file not necessary

The pulp is automatically removed during instrumentation.

Instrumentation:

Use hand reamers.

Preparation method: serial preparation

Movement of reamer: rotate clockwise

Diameter of first instrument: choose first reamer diameter comparing canal diameter on x-ray at middle canal length. Do not use reamers under nr. 25: danger of breaking. Do not use reamers in narrow canals, only K-Files and H-files. Do not rotate files.

Canal preparation:

Ream canal carefully to the apical portion using a rotating motion.

Take a second x-ray with instrument in place to obtain.

Second measurement (working length):

Compare length of instrument (from apex to stopper on shaft) with x-ray position of instrument in the canal. Eventually correct length.

Establish exact working length (apical constriction). Apex locating device suggested! Ream until no pulp tissue traces remain on reamer.

Disinfection:

Place Rocanal R1 Imediat on reamers.

Disinfection occurs while you ream.

Irrigation:

Do not use sodium hypochlorite or oxygenated water.
Not necessary while you prepare the canal with instrumentation.
Irrigate only at the end of preparation, using Rocanal Irrigation.

Intermediary dressing:

If the canal is not filled immediately with Rocanal R2 permanent filling material at the same visit, place intracanal intermediary dressing.
Close tooth temporarily until the next visit.

Filling:

Normally the permanent filling is done immediately. After tooth reopening (if at second visit) clean canal again with final size reamer using rotating motion. Irrigate with Rocanal Irrigation (do not use sodium hypochlorite or oxygenated water). Dry with sterile paper points and 5 second air blasts. Fill the canal permanently with Rocanal R2 Permanent. The filling must reach the apical constriction (physiological foramen).

Filling instructions:

1. Endodontic cement mixing:

Use flexible spatula. Sterile glass slab. Put one drop of liquid and add powder progressively. Spatulate in a counter clockwise direction (take your time!).

Powder contains crystals which must dissolve in the liquid. Mixing time: approximately 60 seconds. It is possible to add more liquid if mix is too thick or more powder if too fluid.

2. Cement introduction:

Take a minimal dose of mixed cement from long-axis of spatula with Lentulo paste-filler mounted on contrangle (No rotation!).

Note: Lentulo must be tried first by hand to check length and free movement in the canal. Lentulo filler must be placed in the canal to approximately 0.5mm from apical constriction (0.5mm less than working length) without any rotating motion. Start rotation only when Lentulo-filler is in position. Rotate clockwise at low speed and slowly remove instrument from the canal. Cement will remain in the canal without any great extrusion from apex. One single in-out movement is sufficient for a total root canal filling. Do not pump or make side-movements with Lentulo-filler: danger of breakage and overfilling!

Take an x-ray and check filling. If filling is incomplete, immediately proceed with a second filling, following the same instructions given for the first filling. Repeat x-ray for final check.

Gutta-percha:

Rocanal pharmacodynamic system does not suggest the use of Gutta-percha filling methods.

If desired, the traditional technique with the introduction of a master cone after cementation can be used.

Vertical condensation, lateral condensation or hot gutta-percha techniques with syringes are not recommended.

VITAL PULPECTOMY IN MULTIROOTED TEETH

Treatment: the pulp is removed from all the canals in the same sitting if possible.

Procedures: large, straight canals: same as for single rooted teeth.

Narrow canals: no rotatory movements, no reamers!

Use only hand K-files and hand H-files.

If permanent filling is delayed, place an intermediary dressing in the canal.

NECROTIC INFECTED PULP (GANGRENE)

SINGLE ROOT – NORMAL CANAL (LARGE)

Diagnosis: the pulp is not vital. The canal contents is infected, necrotic, gangrenous.

No acute symptoms. Negative reaction to cold test, to electronic pulp test.

Treatment: the root-canal must be cleaned, disinfected, to the apical constriction (physiological foramen).

Particular considerations: the presence of infection in the root-canal requires special procedures to reduce the risk of a flare-up in the periodontal region. The permanent filling of the canal is postponed until a few days later. (The flare-up danger is in the first two or three days after canal debridement).

Presence of sinus-tract (fistula): in this case the canal can be filled immediately after debridement.

No treatment of fistula necessary.

Acute cases: treat acute cases as usually.

Procedures:

X-Ray

No anaesthesia

Access:

Use round diamond bur to create access to the canal (the direction of Penetration is along the long-axis of the tooth).

First measurement:

Compare length of first instrumentation with x-ray canal length.

Canal debridement and disinfection:

Use Rocanal R1 Imediat. The canal debridement is usually done with step down hand instrumentation by rotating reamers in a clockwise direction. The reamers are coated with Rocanal R1 Imediat cream which acts as both disinfectant and lubricant. Reach the apex (apical constriction).

Ream starting with a larger sized instrument and change sizes gradually to a

finer one (step down technique).

Size of first instrument: compare with diameter of the canal on x-ray.

Example of technique: start with nr.50 for the coronal area, change to 45 then to 40 and to 35-30 to reach the apical part of the canal.

Second measurement (working length):

before you reach the apex, take an x-ray with reamer in root canal at apical third. Establish exact working length (apical constriction). Ream until no necrotic traces remain on reamer.

Disinfection:

Place Rocanal R1 Imediat on reamers.

Disinfection occurs while you ream.

Irrigation:

Do not use sodium hypochlorite or oxygenated water.

Not necessary while you prepare the canal with instrumentation.

Irrigate only at the end of preparation, using Rocanal Irrigation.

Prevention of flare-up in the periodontal region:

Canal instrumentation must be done step by step, without forcing debris or the instrument beyond the apex: danger of flare-up! At the end of debridement some Authors suggest the application (past the root-canal, in the periapical area) of a small dose of antiinflammatory-antibiotic cream. For this purpose it is suggested to perforate slightly the apex of the root canal with a K-file nr.15 and to apply the cream beyond the apex using a syringe (short needle placed only to the initial part of the root canal). This must be done at the first visit, after canal instrumentation.

Notes: - The cream is only effective if it reaches the periodontium

- Do not use a Lentulo paste-filler, danger of breakage

- Type of cream suggested (in Switzerland) Betnovate-N Creme (Glaxo)

- Syringe suggested: for insulin 1ml

Intermediary dressing:

Put an intermediary dressing in the root-canal. Use Rocanal R1 on paper cone. Disinfection is well achieved.

Close tooth crown temporarily until the next visit. Do not leave the tooth open if you have applied antiinflammatory-antibiotic cream beyond the apical foramen.

Filling:

At the second visit, if no acute reaction has occurred or if the reaction has calmed, clean the canal again with the final size reamer using rotating motion. Irrigate with Rocanal Irrigation (do not use sodium hypochlorite or oxygenated water). Dry with sterile paper points and 5 seconds air blast. Fill the canal permanently with Rocanal R3 Permanent Gangrene. The filling must reach the apical constriction.

Filling instructions:

Follow the same instructions as indicated above (see vital root canal filling instructions).

MULTIROOTED TEETH (GANGRENOUS)

Treatment:

The root canals must be cleaned and disinfected to the apical constriction. Treat all canals in the same visit if possible. Immediately after canal debridement, apply an antiinflammatory-antibiotic cream beyond the apex. Do not fill the canal permanently: put an intermediary dressing. Close the tooth temporarily.

Procedures:

Large, straight canals: same as for single rooted teeth.

Narrow canals: no rotating motion, no reamers.

Use only K-files and H-files (Hand instruments).

Important: if you start a canal debridement, do not delay total preparation until a second visit by stopping at the middle of the canal: danger of flare-up.

Filling:

Follow the same instructions as per single rooted teeth.

Use Rocanal R3 Permanent Gangrene.

PAIN AFTER PERMANENT FILLING

In case of post-filling pain, do not reopen the tooth or the canal. Filling reactions normally disappear after a few days. Prescribe an antiinflammatory product.

Over fillings:

Rocanal Permanent filling endodontic cements R2 and R3 are well tolerated by periodontal tissues. Over fillings disappear from periodontal region after 6-12 months. Permanent filling in the canal do not disappear.

Note: substantial over fillings are a sign of erroneous filling technique.

Flare-Up

When treating a gangrenous canal, there is always the possibility of an acute reaction, one or two days after canal debridement (flare-up). Inform the patient of this possibility before you start treatment. In case of flare-up, general antibiotic and antiinflammatory treatment is often indicated. The cause of a flare-up must be determined to better point out a specific treatment.

Causes of flare-up:

- infected debris beyond the apex
- over instrumentation
- overmedication with toxic materials like very strong disinfectant (formocresol, formalin, parachlorophenols)
- toxic irrigation solutions like sodium hypochlorite
- haemolytic solutions, like oxygenated water
- irritating materials, like calcium hydroxide, iodoform paste, gutta-percha

To achieve good success, the prescribed technique has to be preferred.

4 CLINICAL CASES

By
Dr. Edgar J. Corneo-Lobenstein

**Typical Clinical Case:
Treatment of chronic
periodontitis originated from
gangrenous canal**

**Retreatment of Inferior
premolar**

**Fibrotic Deformation in
Molar Region of Left Part of
Mandible Caused by Necrotic
Canal Contents**

**Necrosis of Canal Contents
Consequent to Pulp Capping.
Periapical Radiolucencies.**

TYPICAL CLINICAL CASE: TREATMENT OF CHRONIC PERIODONTITIS ORIGINATED FROM GANGRENOUS CANAL



Fig.1 Upper lateral with chronic periodontitis.
Origin: gangrenous canal.
X-ray before treatment.



Fig.2 Measurement with file into canal.

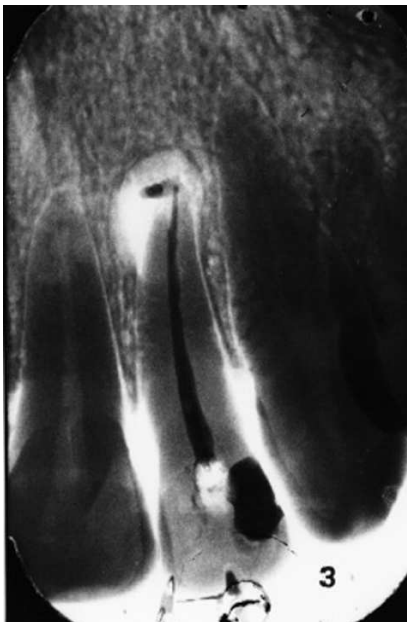


Fig.3 X-ray taken immediately after permanent filling.
No gutta-percha. The cement is slightly overfilled. (No pain, no reaction).



Fig.4 X-ray control after two years.
Overfilling has disappeared.
Periodontium has completely healed.

RETREATMENT OF INFERIOR PREMOLAR

Diagnosis: Chronic Osteitis, Sinus Tract, Resorbtion in Lateral Canal.
Treatment: In one Single Sitting.
Filling: Rocanal Permanent Gangrene no gutta-perca.
Result: Complete Healing. Control after 6 years.

Fig.1 X-ray before treatment
(Sept. 1985)



Fig.2 X-ray control after one year!
Healing very good.
(Sept. 1986)



Fig.3 X-ray control after 6 years.
(Feb. 1992)



FIBROTIC DEFORMATION IN MOLAR REGION OF LEFT PART OF MANDIBLE CAUSED BY NECROTIC CANAL CONTENTS (with great Radiolucency at apices). CHRONIC OSTEITIS

Treatment:	Retreatment of root canals started in March 1988.	Note: The treatment was particularly difficult because the canal entrances of treated canals were obstructed by a resin-filling material. The distal root had a fourth canal (not treated before). The mesial root had a very curved canal (lingual).
Sittings:	3, once a week	
Control X-rays:	1. July 1988 2. October 1988 3. March 1989 4. February 1991 5. May 1994	
Result:	Complete healing	
Filling:	Only with endodontic cement Rocanal Permanent Gangrene.	

Fig.1
 (Feb. 1988)
 Initial Orthopantomography.
 Note: fibrotic reaction of bone all around first molar.
 Great radiolucencies at apices.

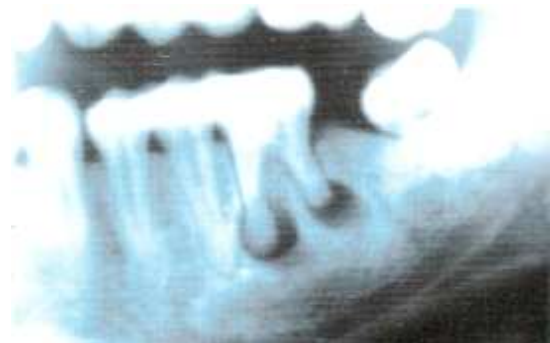


Fig.2
(March 1988)
Endooral x-ray before starting
retreatment.



Fig.3
(July 1988).
First control x-ray.
An overfilling is present at distal root. The
case was perfectly well tolerated. No
pain.



Fig.4
(March 1989).
Control x-ray.
The four canals are well visible.



Fig.5
(May 1994).
Control x-ray.
The healing is complete.
Overfilling diminished.
Clinically perfect healing.



NECROSIS OF CANAL CONTENTS CONSEQUENT TO PULP CAPPING. PERIAPICAL RADIOLUCENCIES

Treatment:	Preparation of canals in 2 sittings. Filling with Rocanal Permanent Gangrene.
Result:	Complete healing. Slight over filling without consequences.

Fig.1
(June 1991)
X-ray before treatment.



Fig.2
X-ray with instrument in distal canal.
Measurement.



Fig.3
X-ray with instrument in mesio-buccal canal.
Measurement.



Fig.4
X-ray in mesio-lingual canal.
Measurement.



Fig.5
X-ray immediately after canal filling.
Slight over filling.
No clinical consequences.



Fig.6
(Jan. 1995)
Control x-ray (eccentric, for better
visibility of mesial canals).
Healing is complete.
Over fillings have disappeared.



PRODUCT PRESENTATION

Rocanal R1 Imediat

Rocanal R2 Permanent vital

**Rocanal R3 Permanent
gangrene**

Rocanal Irrigation solution

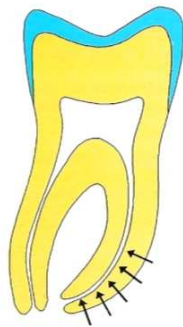
Rocanal

Mixing instructions

ROCANAL R1 IMEDIAT

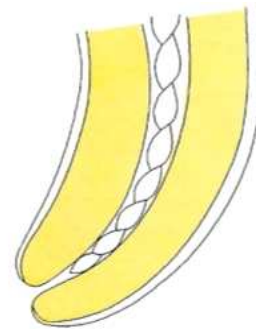
Lubricating and disinfecting cream.

The lubricating action of Rocanal R1 Imediat facilitates negotiation of root canals even when they are curved and tortuous. During instrumentation Rocanal R1 Imediat disinfects even in the presence of blood, pus,... Rocanal R1 Imediat can be left in the canal as an intermediate medication between office visits. Rocanal R1 Imediat is well tolerated if accidentally inserted beyond the apex.



In curved canals it might be very difficult to reach the apex.

The use of a lubricating agent helps negotiate the root canal to the apex and helps avoid perforations and ledging.



Files must be curved and dipped into the cream before use.

When the canal is ready for final filling, remove Rocanal R1 Imediat simply by rinsing with Rocanal Irrigation or sterile water.

Advantages in endodontic treatment

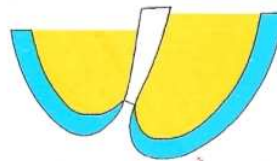
1. Immediate dissolution of all necrotic pulp tissue, even in the presence of organic materials (blood, pus) and in an acid or alkaline environment.
2. Lubricating action on root-canal instruments.
3. Ideal for intermediary dressings in gangrenous canals.
4. Non-irritating to periapical tissues.
5. Toxicity index very low.
6. Easy to insert and easy to remove (water soluble).
7. Neither disagreeable nor dangerous (not caustic).
8. Does not discolour the tooth.
9. Deodorizing action.

ROCANAL R2 PERMANENT VITAL

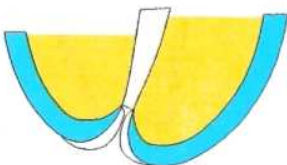
After vital pulpectomy any remaining pulpal remnants, especially in accessory canals, may degenerate with subsequent necrosis and secondary infection. This may result in failure of endodontic treatment.



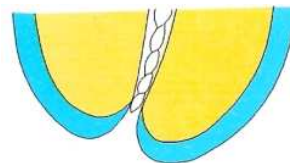
Rocanal R2 Permanent vital is a final root canal filling material. Its unique action helps prevent contamination and protein decomposition particularly under anaerobic conditions.



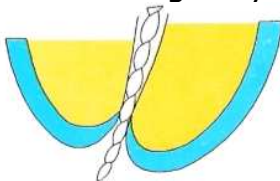
A correct final filling reaches the anatomical foramen.



Rocanal R2 Permanent vital allows the formation of an osteo-cementum which biologically seals the apex.



Pulpectomy: file must stop at the anatomical foramen or at the dentin-cemental junction.



Going beyond the apex may cause painful post operative reaction.

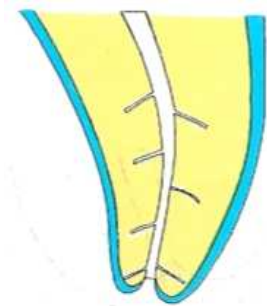
Properties

Contains ortho phenyl phenol	→ Prevents decomposition of pulpal remnants
Volume stability	→ Seals the canal completely
Resorbable beyond the apex	→ Biocompatible, does not irritate tissues
No lead, no silver	→ Contains no toxic ingredients

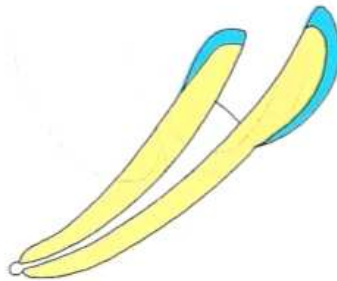
ROCANAL R3 PERMANENT GANGRENE

Rocanal R3 Permanent gangrene prevents failures in endodontic treatment caused by the presence of bacteria.

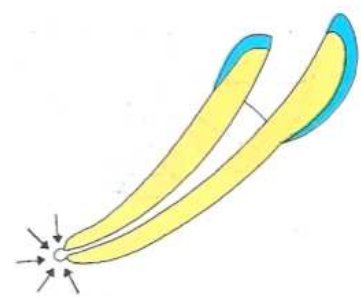
Rocanal R3 Permanent gangrene is a final endodontic cement that prevents the growth of bacteria and secondary periapical complications. During the pre-setting period active ingredients have a diffusion of about 2mm.



If an excess of cement goes beyond the apex, it is well tolerated and is resorbed by macrophages.



Beyond the apex Rocanal R3 Permanent gangrene is well tolerated.



Rocanal R3 Permanent gangrene slowly resorbs if placed beyond the apex.



Properties

Contains ortho phenyl phenol	→ Bactericidal and fungicidal
Volume stability	→ Excellent sealing properties
Resorbable beyond the apex	→ Biocompatible, does not irritate tissues
No lead, no silver	→ Contains no toxic ingredients

ROCANAL IRRIGATION SOLUTION

Disposable cartridges
Root canal disinfecting and cleansing solution.

Rocanal Irrigation disinfects, cleanses, lubricates and rinses the canal in one-step. It is non-irritating and does not cause swelling and pain.

It's packaging meets all requirements to avoid cross-contamination.



Properties

Low surface tension	→	Penetrates easily in the canal
Fungicidal, bactericidal, detergent, deodorant; effective even in presence of blood, pus necrotic tissues, smear layer	→	Creates perfect conditions for final filling
Harmless to oral mucosa; no pain if in contact with periodontal tissues	→	Use of Rocanal Irrigation is safe
Hydro alcoholic solution	→	Dies rapidly in the canal
No staining	→	Does not discolour the tooth

Introductions

Simply use with a standard anaesthetic syringe + needle.

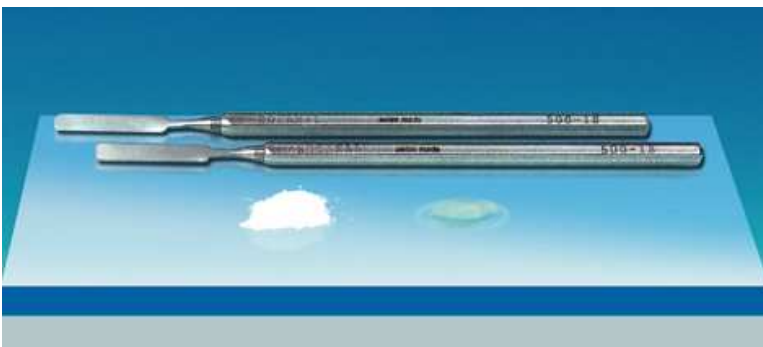
ROCANAL

Formulations of Rocanal endodontic therapy		
Rocanal R1 Imediat Cream	PVP-I complex (Povidone Iodine) Polyethylene Glycol Water	jar 15 g
Rocanal R2 Permanent vital Endodontic cement	Liquid: alcoholic eugenol solution Powder: Zinc Oxide, Titanium Oxide OPP (OrthoPhenylPhenol) Calcium Wolframate	5 ml 8 g
Rocanal R3 Permanent gangrene Endodontic cement	Liquid: alcoholic eugenol solution Powder: Zinc Oxide, Titanium Oxide OPP (OrthoPhenylPhenol) Nitrofurazone Calcium Wolframate	5 ml 8 g
Rocanal Irrigation Hydro alcoholic solution	Benzothonium chloride Phenoxyethanol EDTA	Cartridges 50 x 1.8 ml

MIXING INSTRUCTIONS

For Rocanal R2 and R3

1. Use sterile mixing slab and two single-end flexible sterile spatulas (one for powder, one for mixing).
2. Put one or two drops of liquid and a small quantity of powder on the slab.
3. Mix powder slowly with the liquid, with some pressure on the spatula.
4. Mix as long as needed to obtain a creamy, crystal-free mixture (crystals present in the powder are soluble in the liquid).
5. Proceed with your usual filling technique.



ROCANAL™ is a registered trademark.

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