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An Overview of Various Intracanal Medicaments Used In Root Canal Treatment- A Review

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ABSTRACT:
The goal of endodontic treatment is to remove and kill all micro-organisms in the root canal and to neutralize any antigens that may be left in the canal after killing the microbes. Reaching this goal is expected to guarantee healing of apical lesions. It has become obvious that complete destruction of root canal microbes is a particularly difficult challenge. On the other hand in a high number of cases, high quality treatment is followed by complete healing .it is clear, therefore that although destroying 100% of the infective flora is the optimal goal. Complete clinical and radiographic healing can also occur when the microbiological goal of treatment has not been fully realized. Even then the final success is dependent on successful infection control eradicating pain by use of antibacterial medicaments. This article reviews the antimicrobial effects and the evolution of the various intracanal medicaments.

Keywords: Intracanal, toxicity, antibacterial, infection

I. INTRODUCTION

Endodontic success or failure is related to the absence or presence of signs and symptoms of apical periodontitis and periapical lesions which includes apical granuloma and radicular cyst as well as acute manifestations of inflammation. The aetiology of apical lesionsis primarily a bacterial infection of the root canal system consequently; the technical and pharmacological aspects of pre-vention and treatment are mainly aimed at control-ling infection. Thus, preventiveendodontics emphasizes ontreatment of a tooth with no previous signs of apical periodontitis by aseptic pulp extirpation. Curative endodonticsis the chemomechanical elimination of infection in the pulp canal system and signs of apical periodontitis. Both are completed by the placement of a bacteria-tight filling to prevent reinfection.

The intracanal medicaments play a significant role in endododontics by preventing canal infection where none is presentor by inactivating bacteria already infecting the root canal. Intracanal medicaments include agents with anticipated pharmacological actions when introduced in the root canal. Antibacterial and other active compounds used currentlyduring instrumentation as irrigating solutions justly belong in this group.

Intracanal dressingsdescribe medicaments left in the root canal to exert their action for a longer duration. The efficacy of intracanal medicaments in the infected root canals should be assesed in the follow up appointments by its potency to: Eliminate any remaining bacteria after canal instrumentation, reduced remnant pulpal inflammation, inert the canal contents, neutralize tissue debris, barrier against leakage from the temporary restorations and drying up persistent wet canals. Intracanal medicaments as a part of controlled asepsis should be used only as a root canal disinfectant in infected root canals, secondary to cleaning and shaping of the root canal. Comprehensive canal debridement with adequate canal preparation are more pertinent, and their importance is emphasized. Bacteriological sampling may be necessary if a tooth does not respond to treatment, to help in the choice of intracanal medicament.[1]

Primary Functions of Intracanal medicaments:

The mode of action of intra canal medicaments is attributed to the action of its 3 major components: Antimicrobial agents, Detergents and Disinfectants. Conventional antimicrobials used in high concentration have a destructive effect on the

bacteria causing denaturation of cell proteins. Antimicrobial agents such as phenols, thymol, creosate, Eugenol cause coagulation of proteins and subsequently loss of cell metabolic function may result.Detergents act as germicides by modifying and damaging the physical and chemical properties of the bacterial cell membrane.While antibiotics work through biological interference with essential biochemical processes, disinfectants are a group of chemicals that act by direct toxicity to the microbes. Their action is thus quicker and more general, and they usually have a broader antibacterial spectrum than the antibiotic drugs.[2]

Secondary functions:

Pain during and after treatment may occur, and the tissue reactions associated with affected root canals include exudation, transudation, swelling and resorption. Each of these phenomena, either singly or in conjunction with infection, has been a target for attempts at medication during, between and after treatment sessions.

Itis often considered desirable to allow hard tissue to form to continue apical root development, to close a wide foramen, or to create a mechanical barrier at a fracture line. Although the mechanism of action is largely unknown, dressings are available with claims of inducing hard tissue formation.

Pain is often associated with infection, and the primary means of pain control in endodontic treatment is infection control. Medicaments result in pain reduction through a decrease in the tissue responses in inflammation. Thus, playing a role in alleviating clinical pain threshold from both infectious and aseptic pulpoperiodontal inflammation.

Persistent exudation in the root canal may occur, despite apparently successful technical treatment. Exudation reflects inflammation suspecting a residual infection. Therefore, medicament deals with potential clearance of infection by drying or coagulating the exudate.

Trauma to the teeth may result in various forms of resorptive damage, inflammatory root resorption being the most aggressive and destructive amongst them. Inflammatory root resorption is normally associated with infection of the root canal combined with physical damage to the cementum. The primary function of medicament is to eliminate infection in the root canal followed by influencing the resorption process itself.[3]

INDICATIONS OF INTRACANAL MEDICAMENTS:

- Elimination microorganisms: To sterilize (destroy all viable microorganisms) or to disinfect (destroy all pathogens) in the canal space.
- Rendering contents of canal inert: This represents the attempt usually by chemical means to "mummify", fix or neutralize tissue or debris left intentionally or unintentionally in the pulp space.
- Prevention or control of post treatment pain: The objective is to reduce or alter the inflammatory response.
- Enhancing Anesthesia: By reducing the sensitivity of the inflamed, difficult to anesthetize pulp.
- Control of persistent periapical abscess: In cases of continually "weeping" canal or significant pain or swelling medicaments have been suggested as a means of controlling this difficult situation.[4]

Ideal requisites of an intracanal medicament:

- Should be an effective germicide and fungicide.
- Should not irritate the periapical tissues.
- Should remain stable in solution.
- Should have a prolonged antimicrobial effect.
- Should be active in the presence of blood, serum and protein derivatives of tissues.
- Should have low surface tension.
- Should not interfere with repair of periapical tissues.
- Should not stain the tooth structure.
- Should be capable of inactivation in a culture medium.
- Should not induce a cell mediated immune response.
- Should be easy to handle (place and remove).
- Should be Cost effective.[5]

CLASSIFICATION OF INTRACANAL MEDICAMENTS:

Grossman (Table-2), Dental clinics of North America (Table-3) and Ingle (Table-4) had proposed globally accepted classifications as listed below along with general classification (Table-1).[3,6,7,8]

TABLE-1:

GENERAL CLASSIFICATION	
ESSENTIAL OILS	Eugenol
PHENOLIC COMPOUNDS	Phenol Camphorated Monochloro phenol(CMCP) Camphorated Parachloro phenol (CMPP) Camphorated chloroxylenol(ED84) Cresol Creosote(beech wood) Thymol
ALDEHYDES	Formocresol Glutaraldehyde Paraformaldehyde
HALOGENS	Sodium hypochlorite Chloramine T Iodine
QUATERNARYAMMONIUMCOMPOUNDS	Aminoacridine
ANTIBIOTICS	Triple Antibiotic paste (ciprofloxacin, metronidazole, minocycline Grossman paste Cortico steroids(ledermix) LSTR
CALCIUM HYDROXIDE	

TABLE-2:

GROSSMAN'S CLASSIFICATION	
ESSENTIAL OILS	Eugenol
PHENOLIC COMPOUNDS	Para ChloroPhenol Camphorated Parachloro phenol (CMPP) Formocresol Glutaraldehyde Cresatin
HALOGENS	Sodium hypochlorite Iodide
QUATERNARYAMMONIUMCOMPOUNDS	Aminoacridine

TABLE-3:

DCNA CLASSIFICATION -1984	
PHENOLIC COMPOUNDS	Eugenol Camphorated monoparachlorophenol (CMCP) Parachlorophenol (PCP) Camphorated parachlorophenol (CPC) Metacresylacetate (Cresatin) Cresol Creosote (Beechwood) Thymol
ALDEHYDES	Formocresol Glutaraldehyde
HALIDES	Sodium hypochlorite Iodine- Potassium iodide

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ANTIBIOTICS
STEROIDS
CALCIUM HYDROXIDE
COMBINTIONS

TABLE-4:

INGLE'S CONVENTIONAL ANTISEPTICS AS INTRACANAL MEDICAMENTS	
PHENOLIC COMPOUNDS	Eugenol Camphorated monoparachlorophenol (CMCP) Parachlorophenol (PCP) Camphorated parachlorophenol (CPC) Metacresylacetate (Cresatin) Cresol Creosote (Beechwood) Thymol
ALCOHOLS	Ethyl alcohol Isopropyl alcohol
HEAVY METAL SALTS	Salts of silver, mercury, copper
HALIDES	Sodium hypochlorite Iodine- Potassium iodide
CATIONIC DETERGENTS	Quaternary ammonium compounds

ESSENTIAL OILS:

Eugenol ($C_{10}H_{12}O_2$, molecular weight 164.20) is the chemical essence of oil of clove and is related to phenol. It is slightly more irritating than oil of clove and is both an antiseptic and an anodyne. Trowbridge et.al had shown inhibition of intra dental nerve impulses by eugenol. Eugenol is used with combination of other cements, like zinc oxide as a root canal filling material and as a dressing for temporary control of pain after vital pulp exposure. It has a well-documented, but limited, antimicrobial effect and is applied primarily for its pain-relieving effect.[9]

Zincoxideeugenolcement (ZOE), Calen paste thickened with zinc oxide (Calen/ZO), Sealapex sealer and EndoREZ sealer act against 5 common bacterial strains found in endodontic infections (Kocuria rhizophila, Enterococcus faecalis, Streptococcus mutans, Escherichia coli and Staphylococcusaureus).[9,10]

PHENOLS / PHENOL DERIVATIVES:

Phenols or phenol-derivatives, such as paramonochlorophenol and cresol, used to be the most commonly used inter-appointment intracanal medicaments. They were often mixed with camphor to form camphorated solutions to release phenol at a slower rate and make these compounds somewhat less caustic. Cresol is often mixed with formaldehyde to give formocresol. All of these compounds coagulate cell contents indiscriminately and will cause tissue necrosis on contact. These compounds have been proven to be tissue irritating and highly toxic and to have limited antimicrobial effectiveness. The combination of high toxicity and limited clinical effectiveness exclude the phenol-based compounds from the recommended list of contemporary intracanal antibacterial medicaments.[11,12]

Phenols also called carbolic acidis the oldest compound for controlling microorganisms. It was introduced by Lord Lister in 1867.It is white crystalline substance, and has a characteristic odor derived from coal tar.Phenol is a protoplasm poison and produces necrosis of soft tissues by its ability to penetrate and disrupt the cell wall of bacteria and subsequently the protoplasm.Liquefied phenol consists of 9 parts of phenol and 1 part water.This substance is highly effective in as low concentration as 1 to 2%

While phenol itself is no longer used in endodontics because of its high toxicity-to-efficacy ratio, the derivative paramonochlorphenol has been a very popular component of dressings- It has been used as a dressing both in aqueous solution and in combination with camphor (as camphorated mono-chlorphenol, CMCP); it was long recognized as the dressing of choice for infected teeth. Thymol similarly enjoyed widespread popularity, but is less antibacterial than the chlorphenol compounds.

Camphorated phenol contains 30% phenol, 60% camphor, 10% ethyl alcohol. It has excellent antimicrobial and analgesic effect and is least toxic of all phenolic compounds.Camphorating process aims at developing a less caustic medicament as a result of the slow release of phenol. Camphor serves as a vehicle and diluents.In clinical use the phenolic compounds are relatively ineffective as antiseptics.

Monochlorophenol (MCP) is a derivative of phenol and has three isomers of which paramonochlorophenol is most effective.MCP is more effective antiseptic but also more toxic than Camphorated paramonochlorophenol (CMPCP) developed by Walkhoff in 1891. CMPCP contains 35% monochlorophenol and 65% camphorIt has good antimicrobial effect but also highly toxic to the tissues.Its generally used in the vapor form as an intracanal medicament which can pass through the apical foramen.[12,13,14]

Cresatin also known as metacresylacetate is a clear, stable, oily liquid of low volatility. It has both antiseptic and obtundant properties. Compared to formocresol or CMPCP the antimicrobial effect of cresatin is less. Its effect on tissues ranges from mild to severe. Creosote is a mixture of phenol and phenol derivatives. Beachwood creosote has long been used in endodontic therapy. There are several reports on severe tissue irritation and necrosis.

Camphorated Chloroxylenol (ED 84) was introduced in Germany. It is a non toxic liquid medicamentclaimed to be effective as an intermediary root canal dressing for duration of 2 days. It contains chloroxylenol (10%) and camphor (15%)

These agents cause marked destruction of tissues, delays healing.They act as a hapten and alter the tissue to the extent that they may become foreign substances to the body which inducecytotoxicity. It may be carcinogenic and mutagenic.[5]

ALDEHYDES:

Formaldehyde, paraformaldehyde and glutaraldehydeare water-soluble protein-denaturaturing agents widely used in dentistry including endodontics as potential disinfectants. Aldehydes though used as surface disinfectant of medical equipments are quite toxic and allergenic, and sometimes carcinogenic. Formocresol containing formaldehyde as its main ingredientis still a widely used medicament for pulpotomy procedures in primary teeth.Its controversial properties have caused the discontinuation in use of neutral buffered formalin. Para formaldehyde is the polymeric form of formaldehyde, best known for its inclusion in some root canal filling material, e.g. N_2 and endomethasone. It slowly decomposes, to give its monomer formaldehyde.

FORMOCRESOL:

The use of formocresol as a pulp medicament is attributed to Buckley from 1904 to 1906. Buckley outlined the use of a mixture formalin and cresol to treat necrotic or “putrescent” pulps. In the 1930s, Sweet developed a multiappointment pulpotomy procedure that became very popular and is the predecessor for our current single-appointment pulpotomy. In his articles, he recommended a five appointment procedure that he later modified to three appointments. Since then, formocresol has been the subject of a great deal of research.[15]

Buckley, in 1906, gave a popularized formulation of 19% formaldehyde with 35% cresol, 15% glycerol and 31% water to create buckley’s formocresol.Formalin is a strong disinfectant that combine with albumin to form an insoluble, undecomposable substance and fixes the tissues. When it was placed against the pulp tissues it resulted infixation of pulp due to alkalinity of formaldehyde and the proteolizing effect of cresol.

Formocresol is a non- specific bacterial medicament most effective against aerobic and anaerobic organisms in root canals. It may also be used as an medicament in emergency endodontic treatment and in situations where pulpal inflammation is confined to the pulp chamberto relieve pain. Formocresol is also mutagenic and carcinogenic at high concentration hence has to be used in low concentration.Currently we use 1/5th concentration of buckley’s formacresol formula of 120 ml dilutent and 150 ml formocresol. Dilutent is made up of 3parts of glycerin(90 ml) and 1part distilled water (30 ml). In Endodontics the vapors of formocresol are made use of. It is placed on a cotton pellet in the pulp chamber of a tooth in treatment and the vapors will penetrate the entire canal preparation.[11,12]

2% GLUTARALDEHYDE:

It is a colour less oil, slightly soluble in water and has a slightly acidic reaction. It is a strong disinfectant and fixative agent and was first suggested by Gravenmade to be used in concentration of 2% Glutaraldehyde as an intra canal medicament. Glutaraldehyde did not produce any immunologic reaction unlike formaldehyde. The antimicrobial action of Glutaraldehyde is bacteriostatic. Extent of toxicity is less compared to formaldehyde. Its molecular weight is high compared to formaldehyde hence does not penetrate into the periapical tissues.[15]

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HALOGENS:

Halogens include chlorine, iodine and Sodium hypochloriteused in various formulations in endodontics. They are potent oxidizing agents with rapid bacterial effects. Chlorine is released from sodium hypochlorite and from chlorine. The latter release active chlorine at low rate and has been used for short-term dressing of the root canal. Includes chlorine and iodine containing compoundsHypochlorite was first used by Semmelweis in 1847 as a hand disinfectant. This initial use of potassium hypochlorite was substituted by sodium hypochlorite by carrel and Dakin for wound disinfection.[16]

When hypochlorite contacts tissue proteins, nitrogen, formaldehyde and acetaldehyde are formed. The peptide links are broken up and this dissolves the proteins. During the process hydrogen in the amino groups (-HN-) is replaced by chlorine (-NCl-) there by forming chloramine, which plays an important role in antimicrobial effectiveness. Thus necrotic tissue and pus are dissolved and the antimicrobial agent can better reach and clean the infected areas.[17]

Temperature increase significantly improves the antimicrobial effect of sodium hypochlorite.Dakin suggested a 0.5% solution (Dakin's Solution) At this concentration toxicity is low and it affects only necrotic tissue. A 1% sodium hypochlorite solution however is more potent and provides an increased antimicrobial effect. Higher concentrations of NaOCl (2.5% and 5%) attack living tissue without contributing significantly to treatment (i.e ↑ in antibiotic activity) Bystrom and Sundqvist have demonstrated that the rate of root canal disinfection was similar regardless of whether 0.5% or 5% concentration of NaOCl was used. The activity of NaOCl is intense but of short duration. Hence the compound should preferably be applied to the root canal every other day.[18,19]

Iodine is used as iodine, potassium iodide, and in iodophors, which are organic iodine-containing compounds that release iodine over time. It is also a very potent antibacterial agent of low toxicity, but may stain clothing if spilled. As iodoform it was used in a paste formulation to serve as a permanent root canal filling, Current applications of iodine compounds are as an irrigating solution and short-term dressing in a 2% solution of iodine in 4% aqueous potassium iodide and, more recently, as a constituent in gutta-percha points for filling, Some patients may be allergic to iodine compounds, and their use in these patients is contraindicated

These have been used as intracanal medicaments for more than a century. Iodine is highly reactive, combines with proteins at forms salts, which probably destroys micro organism. Iodine - potassium iodide has relative high antibacterial activity and relatively low toxicity.It reportedly demonstrated minimal cytotoxicity to host tissue.It is prepared by mixing - 4gm of KI+2gm Iodine +94grm of distilled water. The solution is flooded into the canvas it does not volatilize and the chamber is covered with dry cotton pellet and temporary seal is given.[19]

Chloramine -T is a chlorine compound used in concentration of 5% It has good antimicrobial qualities. It can be used when the patient gives a history of allergy of iodine compounds. It remains stable for a long period of time.

QUATERNARY AMMONIUM COMPOUNDS:

Aminoacridine is a mild antiseptic. It is more effective than cresat but less effective than CMCP. It works by inhibit bacterial protein synthesis. It has been used more as an irrigant than an intracanal medicament, because of low surface tension.

Heavy metal salts of silver, copper and mercury are used as ICM.They coagulate protiens and act as enzyme inhibitors. Mercury salts are toxic and rendered less effective by the presence of tissue fluid proteinsin the root canal. Hence they have a restricted use.

N_2Contains Paraformaldehyde , Phenylmercuric borate, Eugenol and Additional ingredients like lead, corticosteroids, antibiotics.It is claimed to be both ICM and a sealer. On contrary, Claims of N_2 having a permanent disinfectant action and unusual antimicrobial properties have been denied by the council on Dental Therapeutics of the American Dental Association due to its short antibacterial effect ofabout a week to 10 days.[20]

Cationic detergentshave low surface tension and good cleansing effect, though not so strong wound healing and antimicrobial properties. Mechanism of action is as follows, the 'Quats' are positively charged and the microorganisms are negatively charged. Thus a surface active effect results in which the compound clings to the microorganism and reverses the charge.These compounds are used in the concentrations between 0.1 to 1% for root canal irrigation, but rarely as intracanal dressings. Salvizol is also a detergent suggested for irrigation during root canal instrumentation for its chelating effect but causes mild degree of tissue irritation.[3]

CALCIUM HYDROXIDE:

Calcium hydroxide has proven to be an excellent antimicrobial agent for intracanal dressing. The use of calcium hydroxide as an intracanal antiseptic was first suggested by Hermann in 1920. With the limited resources available, he undertook both laboratory as well as limited clinical trials on humans. Although well documented, his findings were not generally accepted and applied to intracanal use until a generation later. Hermann also recommended calcium hydroxide as wound dressing after superficial pulp surgery such as pulp capping and pulpotomy.

Calcium hydroxide also became used for temporary root fillings after vital pulpectomy Calcium hydroxide was rediscovered in the 1960s for the treatment of necrotic infected pulp. Today it is the intracanal dressing of choice in contemporary endodontic practice. Calcium hydroxide in a water vehicle has antimicrobial qualities that are believed to be due to the very high pH resulting from the dissociation of OH– ions. The powder is poorly dissociated into calcium and hydroxide ions. An aqueous solution is saturated at 0.17%. Thus, most of the calcium hydroxide powder forms slurry in water. This results in some difficulties when depositing the powder in narrow root canals. Glycerine as a vehicle has also been used for the suspension of calcium hydroxide powder. A glycerine paste has a better flow as the Ca(OH)2 dissolves better in glycerine than water. This is deceptive, however, as the hydroxide ion is not dissociated in glycerine. Water must be present for the antimicrobial effect of calcium hydroxide.[21]

Heithersay stated Most of the endodontopathogens are unable to survive in the highly alkaline environment provided by calcium hydroxide. Since the pH of calcium hydroxide is about 12.5, several bacterial species commonly found in infected root canals are eliminated after a short period when in direct contact with this substance . Antimicrobial activity of calcium hydroxide is related to the release of hydroxyl ions in an aqueous environment. Hydroxyl ions arc highly oxidant free radicals that show extreme reactivity, reacting with several biomolccules.[22,23] This reactivity is high and indiscriminate, so this free radical rarely diffuses away from sites of generation. Their lethal effects on bacterial cells are probably due to the: damage to bacterial cytoplasmic membrane, protein denaturation and damage to the DNA.

Calcium hydroxide should ideally be placed deep and densely in the canal space so that its biological effect can be exerted in close proxim-ity to the appropriate tissues. Techniques that deliver dry calcium hydroxide powder alone are difficult or impossible in smaller, more curved canals. Inmost cases, the calcium hydroxide must be mixed with a liquid such as anesthetic solution water, glycerin, other intracanal medicaments, or methyl cellulose to facilitate placement. To use, calcium hydroxide is mixed with glycerin (water is less effective in terms of density to length) to a thick paste and placed in the canal with either aplugger or spun into a lentulo spiral using a counter-clockwise motion. The lentulo spiral (use with caution!) is most effective device for carrying calcium hydroxide paste to length in small, curved canals. The powder alone may be placed with a Messing gun or pluggers in large, straight canals.[4]

ANTIBIOTIC PREPARATIONS:

Antibiotic-containing preparations can be used in endodontic therapy as topical agents. However, the potential for bacterial resistance, the risk of drug hypersensitivity, and the potential to mask certain etiologic factors limit their usefulness. There is no clear scientific evidence for the use of topical antibiotics in root canal therapy. Early investigations evaluated antibiotic-containing preparations: Grossman's polyantibiotic paste, which contains penicillin, bacitracin or chloramphenicol, and streptomycin,and the second a mixture of neomycin, polymyxin, and nystatin. Both of these had some limited efficacy as intracanal medicaments.

A more recent study has shown that Clindamycin gave no advantage as a root canal dressing when compared with conventional root canal dressings such as calcium hydroxide.Further in vitro investigations have produced more favorable results when antibiotic mixtures such as ciprofloxacin, Metronidazole, and Minocycline have been used as topical root canal agents.In an animal study, Windley et al.[23]examined the effects of a triple antibiotic paste of Metronidazole, ciprofloxacin, and Minocycline and found that it was effective in the disinfection of immature dog's teeth with apical periodontitis. Topical corticosteroids have been used as anti-inflammatory of these antibacterial agents is effective against the bacteria commonly involved in endodontic infections. The anti-inflammatory component of these preparations is the corticosteroid dexamethasone, which is less potent than other corticosteroids such as triamcinolone.

Ledermix is a water-soluble paste containing 1% triamcinolone and 3% Demeclocycline. Triamcinolone is 4 times more potent than cortisone and hence can be used in low

concentrations that are unlikely to result in systemic side effects.Originally the manufacturer (Lederle Pharmaceutical) intended the corticosteroid to be the active ingredient; the antibiotic was added not for disinfection but rather to prevent overgrowth of microorganisms following the impairment of the immune defense by the corticosteroid.[23]

Sterilization of the root canal and periradicular region results in good healing of the periradicular region, Bacteria which are present mainly in the root canals and superficial layer of infected root canal wall may be easily removed by conventional root canal treatment. But the bacteria, which remain in the deep layers of root canal dentin, may leak out to periapical region and cause complications. Application of antibacterial drugs to endodontic lesions is one of the clinical procedures that can be used to sterilize such lesions

Endodontic therapy plays an important role in removing bacteria, their by products and their substrates, by disrupting and destroying the microbiolal ecosystem through chemical and mechanical methods. Different drugs and medicaments have also been suggested to accompany these techniques with varying success rate. Besides the use of nonspecific antiseptics, application of antibacterial drugs represents one of the methods of eradicating bacteria in the root canal treatment.

To sterilize such lesions, a single antibacterial drug may not be effective, even if it is a broad spectrum antibiotic. Reason being the bacterial composition of the infected root canals is complex. In addition, bacteria may also invade root canals from other oral sites, e.g. dental plaque, saliva and from carious dentin which may also smear the root canal during endodontic treatment. All such bacteria should be targeted by antibacterial drugs.[24]

The Cariology Research Unit of the Niigata University School of Dentistry has developed the concept of 'Lesion Sterilization and Tissue Repair (LSTR) therapy that uses a triple antibiotic paste of ciprofloxacin, Metronidazole, and Minocycline, for disinfection of oral infectious lesions, including dentinal, pulpal, and periradicular lesions. Repair of damaged tissues can be expected if lesions are disinfected. Metronidazole is the .first choice because it has a wide antibacterial spectrum against anaerobes. However, some bacteria are resistant to metronidazole, and hence, ciprofloxacin and minocycline are added to the mix.

The combination of drugs has been shown to penetrate efficiently through dentine from the prepared root canals especially from the ultrasonically irrigated root canals. The commercially available drugs are powdered and mixed in a ratio of 1:3:3 (3 Mix) and mixed either with macrogol-propylene glycol (3 Mix-Mi') or a canal sealer (3 Mix-sealer).W A 1:1:1 ratio of the drug combination has also been used. Although the volume of the drugs applied in this therapy is small, care should be taken to check if the patients are sensitive to chemicals or antibiotics. A disadvantage of the triple antibiotic paste is tooth discoloration induced by minocycline. Cefaclor and fosfomycin are proposed as possible alternatives for minocycline, in terms of their antibiotic effectiveness, but further clinical studies are needed to demonstrate their efficacy in the root canal.[25]

Oral lesions have been analyzed with strict anaerobic conditions to understand the target bacteria in endodontic treatment and on this basis, antibacterial drugs have been selected. Metronidazole has a wide spectrum of bactericidal action against oral obligate anaerobes, even against isolates from infected necrotic pulps and, in fact more than 99% of bacteria found in carious lesions and infected root dentine were not recovered in the presence of 10ug per ml Metronidazole in invitro experiments. However, Metronidazole, even at a concentration of 100ug per ml, could not kill all the bacteria, indicating that other drugs may be needed to sterilize the infected root dentine. It has been reported that a mixture of antibacterial drugs, i.e. Metronidazole, ciprofloxacin, and minocycline, can sterilize the root dentine.[26]

Research with topical antibiotics has shown that a combination of metronidazole, ciprofloxacin, and rninocycline is effective in killing common endodontic pathogens from necrotic/infected root canals in vitro this antibiotic combination is also an effective disinfectant. Furthermore, the triple antibiotic paste has been used successfully in regenerative endodontic treatments and in healing of large periradicular lesions. Caution should be taken in general when giving local or systemic drugs. Although the volumes of the drugs applied in this therapy were small and there were no reports of side effects, care should be taken if patients are sensitive to chemicals or antibiotics. The compounding of the triple antibiotic paste was standardized in this series of cases. Each batch of the triple antibiotic pastes was compounded within 24 h of use and was removed from the canals after every 1 month of placement for 3 months. The antibiotic paste contained 100 mg of each of the three antibiotics in a total volume of 0.5 ml. The pharmaceutical carrier propylene glycol was used. These ingredients allow increased solubility and delivery of the paste into the canal. Aqueous solutions of antibiotics can often degrade

and this degradation is increased by a rise in temperature and pH.

FREQUENCY OF MEDICATION

According to the general principles of root canal management, disinfectant dressings should preferably be renewed in a week and not longer than 2 weeks because dressings become diluted by periapical exudate and are decomposed by interaction with the microorganisms.

The mode of application traditionally was a short blunt absorbent point moistened with the medicament is placed in to the canal, a cotton pellet from which excess medicament has been expressed is placed in the pulp chamber and the access cavity is sealed.It can be placed into the canal using a lentulospiral and then condensed with a finger plugger, Can be injected using a 30 gauge needle, Can be placed by using cotton pellet in pulp chamber. In narrow canals a dry absorbent point is inserted and a cotton pellet moistened with the medicament is placed against the absorbent point to moisten it. A dry cotton pellet is used to absorb the excess medicament and the cavity is sealed.

However many endodontics prefer to place a medicated cotton pellet in the chamber from which excess medicament has been removed. They depend on the vaporization of the medicament in the pulp chamber for antibacterial action. They do not place an absorbent point in the root canal. The canal is then sealed with a temporary restorative material.

LIMITATIONS OF INTRACANAL MEDICAMENTS:

The therapeutic action of these medicaments depends on direct contact with the tissues. Butthese substances probably do not reach all the areas where bacteria or tissues are presentand have limited surface action only.For theintracanal medicaments to be effective these agents should remain chemically active during the time of inter appointments. Phenols lose their activity very quickly within 24 hrs. Calcium hydroxide retains the antimicrobial action for a prolonged period.Sustained release delivery systems have been evaluated, but their clinical effectiveness is unknown.Intra canal medicaments in endodontics have been used for a number of reasons in the past and presently.Often, different chemicals or drugs are combined in a "cock tail" in an attempt to elicit a variety of effects with a single application.After reviewing in vivo and in vitro research, there is a decided evidence of lack of clinical effectiveness of ICM's. What is clear from the research is the toxicity and potential allergy of the commonly used ICM with the exception of intracanal steroids and calcium hydroxide which have shown promising results.

II. CONCLUSION:

Elimination of microbial contamination from the root canal system is a prerequisite to thesuccessful outcome of the root canal treatment.The evidence shows that mechanical instrumentation, irrigation & use of inter appointment medication are all important in this regard.Thorough canal debridement & adequate canal preparation along with irrigation are more pertinent &their importance is emphasized.However, intracanal medicaments should be used only for root canal disinfection as a part of controlled asepsis in infected root canals & their role is secondary to cleaning & shaping of the root canal.

Advances in technique of shaping and cleaning have lead to single visit endodontics. Hence, intracanal medicaments are of use only in case of multiple visits. The most commonly used intracanal medicaments are Calcium hydroxide in modified easy delivery systems, Chlorhexidine and Formocresol. However, all of the currently available antimicrobialmaterials for root canal irrigation and medicationhave limitations, and the search continues for theideal irrigant and intra-appointment medicament.

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