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Triple Antibiotic Paste: A Suitable Medicament for Intracanal Disinfection

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ABSTRACT

BACKGROUND

The need for treatment modality innovations grows as the number of patients of odontogenic infections rises. Because of the intricate structure of the root canal, the right medication and disinfection must be chosen. In addition, inadequate root canal space cleansing and disinfection leads to a worsening of the issue. Irrigation and manual preparation won't be helpful in these situations. The success of the treatment mostly depends on the appropriate intracanal disinfectant and medication selection, as well as their appropriate application. Triple antibiotic paste (TAP), a combination of three antibiotics, is one such intracanal disinfection. The combination of the three medications in the paste creates a strong antibacterial agent that is effective against microorganisms.

Keywords: Endodontics, Triple antibiotic paste, Microorganism

Introduction

Because endodontic treatments maintain the integrity of the dental arch in the oral cavity and ensure that teeth function appropriately and are preserved, they meet the criteria for advanced dental procedures and vital relevance [1]. Many strategies have been put forth, spanning from traditional to cutting-edge preprocessing methods. The field of endodontics treats permanent and deciduous teeth using pulp treatment. Antibiotics, in particular, used in root canal therapy, have progressively demonstrated how important they are and how important a role they play in producing favorable results when used in conjunction with clinical therapy. Odontogenic infections are infections that originate in the tooth structure. Like all infections, these ones involve a variety of organisms, necessitating the use of several medications to attack the species causing the lesion [2]. As a result, antibiotics are now an essential component of dental care. Different antibiotic formulations are used to treat various illnesses as well as for preventative purposes [3]. Successful treatment of odontogenic lesions with endodontic etiology requires effective decontamination. Despite the fact that endodontic instruments and irritants are the main tools for disinfecting and decontaminating the canal area, some conditions necessitate their usage due to the prevalence of bacteria.

It is impossible to exaggerate the significance of intracanal drugs, especially when dealing with resistant lesions. In order to create a sterile environment in the root canals—which are home to pathogenic microbes—intracanal medicaments are materials that are briefly inserted [3, 4]. The intricate structure of the root canal shields endo-pathogens from the effects of irrigation and instrumentation in persistent, long-term infections. It takes more than one antibiotic to eradicate harmful flora, hence a cocktail of medications known as "triple antibiotic paste" (TAP) is advised. This mixture is highly effective against a variety of bacteria, both gram-positive and gram-negative, obligatory and facultative, promoting healing

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at the site. It does this by removing any microbial colonization from the root canal system, which helps to sterilize and disinfect it. For young, immature teeth, it permits the radicular area to receive and grow new tissue during regenerative therapy. TAP can also help establish a discipline that will enable the successful implementation of additional required and desired therapies. Finally, TAP has good applicability as an antibacterial intracanal disinfectant due to its exceptional regeneration and disinfection properties [5, 6].

The ideal requirements of intracanal medicaments include: (i) the drug should not be irritating in nature, (ii) it should not cause staining, (iii) it should be highly effective in order to be used widely and referred to as biocompatible, and (iv) it should be able to effectively create positive outcomes over an extended period of time and be excellent at repairing the injured peri-radicular tissue.

TAP is extremely effective in the treatment of weeping canals. Additionally, it can also be applied to neutralize tissue debris, destroy any lingering microorganisms in the canal, and prevent dressing leaks.

MEDICAMENTS USED

The TAP was developed with significant assistance from Hoshino and associates in order to remove bacteria from the radicular system, particularly for reasons of regeneration. [7] TAP offers a wide broad spectrum activity by combining the antibacterial qualities of three different antibiotics: minocycline, metronidazole, and ciprofloxacin. Ciprofloxacin is a fluoroquinolone of the second generation that has a wide range of activity and superior tissue penetration. By attaching to and damaging DNA, the nitroimidazole molecule metronidazole has a bactericidal effect on cells, ultimately leading to fast cell death. It works incredibly well against protozoa and anaerobes.

Minocycline inhibits protein synthesis by binding to the 30S ribosome and exerting a wide range of bacteriostatic effects. It is a semisynthetic derivative of tetracycline that possesses many unique properties apart from its bacteriostatic action, including preventing tissue degeneration by the inhibition of collagenases and anti-resorptive properties by the inhibition of clastic cells. [8] Decades before TAP was created, Herman initially introduced CH as a pulp-capping substance. [9] When in contact with aqueous solution, CH separated into OH- and Ca^{2+} ions.

liquids. With a pH of 12.5–12.8, CH is a potent base that has a variety of therapeutic benefits, making it a widely used root canal medication even today. The cytoplasm, proteins, and DNA of endodontic pathogens are denatured and destroyed by CH, which also has a bacteriostatic impact later on when pH falls. [10]

PREPARATIONS: According to Hoshino et al, 1996 the TAP preparation contains an Antibiotic mix: Carrier = 5: 1 can heal periapical lesions. Antibiotic mix - Ciprofloxacin: Metronidazole: Minocycline = 1: 1: 1 or 33%: 33%: 34% Carrier - Macrogol ointment and propylene glycol 0.1-1.0 mg/ml concentration To overcome some of the side effects of Conventional TAP, modified TAP (MTAP) is described in the literature combining

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Ciprofloxacin, Metronidazole, and Clindamycin 30% of each with 10% of iodoform to improve its radioopacity. [11, 12] CH preparations: CH powder is mixed with various types of vehicles such as water-soluble substances, viscous vehicles and oil-based vehicles. The type of the vehicle directly influences both physical and chemical properties and thereby determines its clinical application. As an example, viscous and oily vehicles extend the time of medicaments remaining within the canal and outstretch the action of CH compared to water-based preparations. [13]

INDICATIONS

1.Root canal Disinfection

As was already noted, TAP works well to disinfect the radiation system and break down the resistance of poly bacteria because of its broad spectrum effectiveness against bacteria, including actinomyces, aerobes, and anaerobes. According to one systematic review, TAP is the most effective root canal medication for overcoming bacterial resistance. [9] TAP is suggested as a root canal disinfectant in re-treatment instances as well since it has twice the depth of penetration in dentine and bacterial destruction as Calcium Hydroxide (CH). Even though TAP has shown superior action compared to CH against E. fecalis, which is a commonly identified pathogen in re-treatment cases, TAP is slightly inferior to combined preparations of CH and chlorhexidine (CHX) for the same. [14] MTAP has proven to have better root canal disinfection properties than TAP with fewer adverse effects. [15]

2.Management of periapical lesions

TAP is indicated in the treatment of periapical abscesses, periapical granulomas or even large periapical lesions (possibly small radicular cysts). [16] Another systematic review by Kumar et al, 2021 stated that TAP can be successfully used to manage large periapical lesions nonsurgically where other conventional root canal medicaments failed. The protocol for non-surgical management, in some reported cases, is intra-canal aspiration followed by TAP paste for 2 weeks. It is a conservative approach compared to surgical endodontics. When non-surgical endodontic therapy fails, TAP can still be utilized in multidisciplinary treatment, such as endodontics combined with surgical enucleation.

3.Endodontic flare-up

An abrupt worsening of periapical disease after the start of orthograde root canal therapy is known as an endodontic flare-up. This does not happen often, and the incidence is 2-20% recorded. [17] According to certain research, using TAP as an intra-appointment intra-canal dressing can lower the risk of an endodontic flare-up. [18] Moreover, TAP works faster than CH to reduce persistent endodontic flare-ups. This is due to the combination of minocycline's anti-inflammatory properties and the antibiotic mixture's potent antibacterial action working in concert. [19,20]

4. Management of inflammatory root resorption

TAP has been described as an intra-canal medicament to halt external inflammatory root resorption as it has an extensive antibacterial effect on bacteria residing in necrotic pulp, dentinal tubules and even in the periapical area. Once the causative agents are removed, the inflammatory resorption will automatically halt. Further, Minocycline has an additional

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unique property in arresting the inflammatory resorptive process by inhibiting collagenases and clastic cells. [13] Similarly, CH is also widely used to manage root resorption. CH reverses inflammatory resorption by neutralizing the acidic environment, retarding osteoclastic activity and promoting repair through Alkaline Phosphatase activity. [10]

5. Management of root fracture

Both CH and TAP are ideal inter-appointment root canal dressings for treating teeth with horizontal root fractures, Following treating the coronal fractured part with TAP for 2 weeks, A Mineral Trioxide Aggregate (MTA) plug can be utilized to close the root canal at the fractured end after treating the coronal broken section with TAP for two weeks. Every case report shown excellent effectiveness in curing symptoms and healing the fracture site. [13, 21]

6. Deciduous teeth in pulp therapy procedures

With acceptable long-term outcomes, CH is a pulp treatment substance that is frequently employed in deciduous teeth. [10] It is applied during pulpectomy, pulpotomy, and pulp capping procedures. A few research cite instances in which pulpectomy with CH dressing is followed by an acceleration of root resorption. Numerous studies have endorsed TAP as an interim dressing for pulpectomy treatments of primary teeth with varying success rates. [22] TAP can be utilized for noninstrumented endodontic operations, especially for teeth with good pre-operative exterior or internal resorption, even though the success rate is not as high as for pulpectomy procedures. [23]

7. Regeneration and revascularization of permanent immature teeth

Regenerative endodontics is a biologically based method of treating immature permanent teeth in which the host's tissues are infused into sterile circular area, enabling the tooth to experience root maturation and apexogenesis after the clinical signs of apical periodontitis have disappeared. [24] In addition to these benefits, this method can be used in situations where very young roots make apexification difficult or impossible to perform.

DRAWBACKS OF INTRA-CANAL MEDICAMENTS

Effect on Dentin

Research has indicated that TAP demineralizes dentin, causing particular alterations in its mechanical properties that result in the tooth being brittle. Compared to MTA at the same dosage, TAP treatment significantly reduces microhardness at 500 µm from the pulp dentin complex at a higher dose of 1g/ml. The reason for this is because minocycline induces the dentin to chelate calcium [25].

Effect on Tooth Colour

Teeth discoloration is one of the main side effects of TAP, and minocycline is the cause of this. The usage of additional medications, such as cefaclor and amoxicillin, can alleviate the issue. Tooth discoloration has also been demonstrated to be largely prevented by the use of dentin bonding chemicals [26].

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Effect on Stem Cells

TAP is a crucial substance that is utilized in regeneration. It is important for maintaining the apical stem cell's health and, consequently, for creating an environment devoid of microbes, which allows stem cells to multiply and aid in regeneration [27]. Although compounds such as calcium hydroxide can be utilized, it is best to avoid using them due to their harmful effects on the apical papilla. TAP, on the other hand, has shown to be the best intracanal disinfection substance with excellent qualities, overcoming this disadvantage.

Limitations of TAP

Tooth discolouration is one of the major drawbacks of TAP. Studies have found that TAP was most linked to discolouration when compared to other antibiotic pastes like Ledermix, polyantibiotic paste, and Septomixine Forte. As a result, in some cases, the use of double antibiotic pate (DAP) containing only ciprofloxacin and metronidazole has been suggested. In other investigations, it was discovered that using DAP or TAP for a month reduced dentin microhardness considerably [27].

CONCLUSION

Thoroughly and completely eliminating pathogenic microorganisms from the diseased root canal space is essential for the endodontic treatment to be successful. Even while mechanical preparation is the initial stage, it is insufficient to fully cleanse the area. The investigation of non-instrumentation methods, such as tooth repair and methods for preserving an environment conducive to pulp regeneration and revascularization, is warranted, particularly in situations when the local administration of medications—especially antibiotics—has proven to be ineffectual. TAP has been demonstrated to be the most successful of all. TAP, a combination of three distinct antibiotics, exhibits remarkable efficacy against a variety of bacteria. Three distinct medicines working together also lessens the likelihood of germ resistance. The best antimicrobial agent must be chosen because each one has pros and cons. There are various antimicrobial agents on the market. Without a doubt, TAP has shown to yield positive outcomes.

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