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Research Article

Past to Future of Neem in Endodontics – A Narrative Review

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ABSTRACT:
Neem (Azadirachta indica) has been investigated for its antimicrobial and anti-inflammatory properties in endodontic treatments. This review examines neem's efficacy against root canal pathogens, its potential as a herbal root canal irrigant, and its synergistic effects with conventional endodontic irrigants. Studies demonstrate neem's antimicrobial activity against E. faecalis, Candida albicans, and other endodontic pathogens, reducing bacterial load and biofilm formation. Clinical trials and in vitro studies highlight neem's potential as an adjunct to conventional endodontic treatments, enhancing treatment outcomes and patient comfort. This comprehensive overview underscores neem's therapeutic potential in endodontics, offering a natural, effective, and sustainable approach to root canal therapy.

Keywords: Neem, Endodontics, Antimicrobial, Anti-inflammatory, Root canal Irrigant

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INTRODUCTION:

The development of pulpal and periapical illnesses is primarily caused by various microorganisms. The ultimate goal of root canal therapy is to eradicate all microorganisms from the pulpal space. (1,2) This is accomplished by obturating the root canal space in three dimensions after a comprehensive chemo-mechanical preparation. Although many bacteria in the pulpal space are eliminated by mechanical instrumentation, the residue of bacteria that remain in the intricacies of the pulp space can induce or maintain inflammation of the periradicular tissue. (3,4) Thus, in addition to mechanical instrumentation of the pulpal area, several irrigation solutions and inter-appointment medicaments are used.

The rich legacy of traditional medicines in India is well-known. There has been a paradigm change in endodontics over the past ten years towards using phytochemicals, as herbal medicines

and holistic treatment have grown in popularity with the general public. Herbal root canal irrigants and intracanal medicaments have fewer side effects, less toxicity, less staining of the teeth, and reduced microbial resistance. They also have more antibacterial and anti-inflammatory activity, as well as being biocompatible and easily obtainable.

The most valuable traditional medicinal herb is probably neem (*Azadirachta indica*). A household's traditional medication has been made from every component of the tree, a cure for a variety of human illnesses. The tree is still present and thought of as an Indian "village dispensary." (5) Neem is regarded as a powerful antiviral, antifungal, and antibacterial herb that has been successfully used to treat dental plaque, gingivitis, and endodontic irrigants. (6-9) Various research was done to assess the effectiveness of neem as an herbal endodontic irrigant and intracanal medicament. This review article will narrate various applications and properties of neem in endodontics.

APPLICATIONS OF NEEM IN ENDODONTICS

I. Used as root canal irrigant

II. Used as intracanal medicaments

III. Used as GP disinfectant

I. NEEM AS HERBAL ROOT CANAL IRRIGANTS:

A traditional endodontic irrigant can effectively dissolve biofilm, break down collagen, disintegrate pulp tissue, and remove the smear layer. It is essential that this irrigant is non-toxic and non-carcinogenic to the surrounding tissue cells, does not compromise the sealing capability of dental sealers, avoids irritating the periapical tissues, and is easily obtainable. Because of its antibacterial properties and capacity to dissolve organic materials, sodium hypochlorite (NaOCl) has continued to be the gold standard for root canal irrigation. Still, it irritates the periapical tissues, damaging the surrounding tissues, has disagreeable flavor, is extremely toxic, fails to eradicate smear layer corrosive to tools, and decreases the tensile strength and modulus of elasticity in dentin. (9)

PROPERTIES OF NEEM AS HERBAL ROOT CANAL IRRIGANTS:

1. Antimicrobial efficacy

A. Action of neem against dentinal biofilm

B. Action of neem against oral microbes

C. Action of neem against *Enterococcus faecalis*

D. Action of neem against *Candida albicans* and *Staphylococcus aureus*

2. Smear layer removal or chelating ability

A. ACTION OF NEEM AGAINST DENTINAL BIOFILM

Microbial communities encased in a matrix, known as biofilms, are formed when cells stick to surfaces or one another. (10) The intracanal microbiota plays a primary and secondary role in infected teeth and can form biofilm structures, which are made up of rods, filamentous bacteria, and cocci. [11]

In a study by Zarna Sanghvi et al. [2015] (12), the antibacterial efficacy of *Azadirachta indica* (Neem), *Mimusops elengi* (Bakul), and Chlorhexidine (CHX) gluconate was assessed against biofilms including *Streptococcus mutants, Enterococcus faecalis, Staphylococcus aureus*, and *Candida albicans*. This study stated that the methanolic extract of *A. indica* (Neem), *M. elengi* (Bakul), and CHX gluconate had significant antibacterial efficacy against the biofilm of *S. mutans, E. faecalis, S. aureus, and C. albicans.*

B. ACTION OF NEEM AGAINST ORAL MICROBES

Oral microorganisms are the main causative agent for many oral diseases. Many researches were done on herbs to evaluate their antibacterial efficacy against oral microorganisms (13).

Kalita C et al. [2020] (14) did research to evaluate the antimicrobial efficacy of *A. indica* (Neem), *Ocimum sanctum* (Tulsi), and *Vitex negundo* (Pochotia) against oral microorganisms and stated that the isolated microorganisms were *Klebsiella oxytoca, Kochuria kristinae, Acinetobacter boumani, Sphingomonas paucimobilis, Pseudomonas fluorescens, Streptococcus gordonii, E. faecalis, and Bacillus subtilis*. *A. indica* (Neem) and *Vitex negundo* (Pochotia) both showed increased bactericidal efficacy against *E. faecalis*. When comparing the acetone and aqueous extract groups, the acetone group demonstrated more effectiveness.

C. ACTION OF NEEM AGAINST *Enterococcus faecalis*

Enterococcus faecalis, a Gram-positive coccus that is mostly responsible for nonhealing periapical lesions, is particularly difficult to eradicate from the root canal system. (15,16) This challenge highlights how crucial it is to receive proper endodontic treatment, which gets rid of this bacterium.

Surana et al. [2024] (17) assessed the Minimum Inhibitory Concentration and Minimum Bactericidal Concentration of extracts of *Curcuma longa, A. indica*, and green tea against *E. faecalis* and found that green tea had the strongest antimicrobial activity of all the herbal extracts tested. The antibacterial qualities of *C. longa* and *A. indica* were also evident but required greater doses for efficacy.

D. ACTION OF NEEM AGAINST *Candida albicans and Staphylococcus aureus*

A potential reason for root canal therapy failure are *Candida albicans, Enterococcus faecalis, and Staphylococcus aureus*. (2018) During root canal therapy, *E. faecalis* is linked to periradicular lesions that linger. It is possible to classify *C. albicans* and *S. aureus* as dentinophilic microorganisms as they are members of the microbiota after endodontic therapy has failed. (19) C. albicans is identified in 18% of the root canal failure cases, (20) whereas S. aureus is identified in 0.7%–15% of the cases. (21)

Dedhia J (2018) (22) conducted the research to evaluate the antibacterial efficacy of *Andrographis paniculata*, *A. indica*, and *C. longa* as an endodontic irrigant, against *S. aureus* and *C. albicans* and concluded that *A. indica* also showed antibacterial effect against *C. albicans* and *S. aureus*.

2. SMEAR LAYER REMOVAL OR CHELATING ABILITY

The most widely used technique for achieving total disinfection in the root canal system is chemomechanical debridement. Unintentionally, chemomechanical preparation creates an unstructured layer known as the "smear layer" that might contain microbes and debris lodged in it. (23) It is necessary to remove the smear layer to achieve successful endodontic treatment. The removal of the smear layer has involved the use of numerous chelating chemicals, including citric acid, maleic

acid, and ethylenediaminetetraacetic acid. However, dentinal erosions, allergic reactions, problems with biocompatibility, and a decrease in dentin microhardness are the drawbacks that are frequently seen while utilizing these chemical compositions. (24–26). Herbal extracts are becoming increasingly popular as endodontic irrigants; that's why many studies are looking into more biocompatible natural agents.

Using scanning electron microscopy analysis, Sebatni MA [2017] (27) investigated the effectiveness of three herbal extracts (green tea, orange oil, and neem leaf) in removing smear layers from canals. The results showed that neem extract had significantly higher smear layer dissolution efficiency compared with other agents.

INTERACTIONS OF NEEM WITH OTHER IRRIGANTS:

Comparatively, combinations of irrigants showed higher efficacy in smear layer removal and antibacterial efficacy than single irrigants. (28,29) However, studies showed that CHX and sodium hypochlorite used in combination will form a reddish brown precipitate called para-chloraniline. This precipitate can occlude the dentinal tubules, thereby preventing the penetration of root canal sealers and intracanal medicament. (30-33)

The International Agency for Research and Cancer (IARC, 2006) grouped para-chloroaniline as group 2B carcinogen, which causes less carcinogenicity in humans and experimental animals. (34-41)

Siddique et al. [2019] (42) conducted a study to identify the product formed during combined use of irrigants such as CHX, sodium hypochlorite, neem, and tulsi and concluded that para-chloroaniline was detected in all irrigants combined with chlorhexidine.

II. NEEM AS INTRACANAL MEDICAMENTS:

Because intracanal medications have longer-lasting effects than irrigants, it is advised or indicated to fill root canal space in between sessions. If the antiseptic intracanal medications are not administered correctly in between the visits, the residual microorganisms may multiply to the same extent as they did during the first phase of the treatment. It is therefore imperative to use effective intracanal medications.

The most often used endodontic medication is calcium hydroxide, which, when applied as a seven-day dressing, has a pH of 12.8, which renders most germs inactive. However, the kind of carrier and how calcium hydroxide is delivered affect its antibacterial action. It has also been discovered that *Enterococcus faecalis* is resistant to calcium hydroxide. (43)

The research was done by Venigalla BS et al. [2015] (44) to compare the antibacterial efficacy of calcium hydroxide against *Enterococcus faecalis* with and without the addition of herbal medicines like turmeric and neem extracts. The results showed that all the groups had antibacterial activity against *Enterococcus faecalis* but calcium hydroxide and saline.

combination showed best efficacy against *E. faecalis*, while neem showed better efficacy than turmeric.

III. NEEM AS GP DISINFECTANT:

The most popular obturating substance used to fill root canal spaces nowadays is gutta-percha. They are easily removed from the root canal space and are thermoplastic, radiopaque, dimensionally stable, and biocompatible. (45) According to some authors, decontamination of gutta-percha cones is not necessary because they are produced in an aseptic environment, have strong antimicrobial properties due to their zinc oxide component (46), and have been used straight out of their sterile packages. It is also possible that the risk of contamination of the gutta-percha cones during storage will arise from handling them with gloves or from other physical sources.

Since Gutta Percha cones cannot be sterilized in a hot air oven or by traditional autoclaving, they must be quickly decontaminated before use to maintain the aseptic condition necessary for successful endodontic therapy. (47,48).

Shailja S et al. [2018] conducted a study to assess the efficacy of chemical agents and herbal alternatives, such as Aleo vera, Neem, and Amla, for the quick decontamination of Gutta Percha cones (49) and concluded that chlorhexidine was effective in disinfection of Gutta Percha cones for 1 min, followed by glutaraldehyde and sodium hypochlorite. Whereas, Amla was the most effective herbal extract in disinfecting GP, followed by Aloe vera and Neem.

CONCLUSION:

In conclusion, neem demonstrates significant potential in endodontics due to its antimicrobial properties, biocompatibility, and anti-inflammatory effects. Its natural compounds, such as azadirachtin and nimbolide, can effectively inhibit pathogenic bacteria, making neem a promising alternative or adjunct to traditional endodontic treatments. Furthermore, its ability to promote healing and tissue regeneration could enhance outcomes in root canal therapy. Continued research and clinical trials will be essential to fully understand its efficacy and optimize its use in dental practices, paving the way for more holistic and sustainable endodontic solutions.

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