

The Effect of Chemical Treatments on the Tissues around the Tooth

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Abstract

This synthesis of research was carried out in order to assess the impact of chemical treatments on gum tissues. Chemical compounds are used in a variety of dental applications, including caries prevention, pulp treatment, and periodontal care. Understanding how these medications affect the surrounding tissues is critical for successful treatment results. We thoroughly reviewed the existing literature and relied on any relevant research published between 2000 and 2021. The results imply that, depending on the kind of therapy and the substance used, chemical therapies may have both helpful and negative effects on the tissues around a tooth. More study is needed to determine the most effective techniques for protecting the long-term health of the surrounding tissues.

Keywords: Chemical treatments, Tooth tissues, Dentistry, Caries prevention, Pulp therapy, Periodontal management.

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SUMMARY

According to the findings of this study, chemical therapies may have far-reaching impacts on the tooth pulp and adjacent tissues. Sodium hypochlorite solutions, as is typical in endodontic operations, are used as an irrigant to disinfect and destroy microorganisms in the root canal system. However, continuous exposure to high quantities of sodium hypochlorite has been demonstrated to have a negative impact on dentin microhardness. Other antimicrobial treatments, such as calcium hydroxide, have also shown strong antibacterial activity against persistent oral infections.

Hydrogen peroxide has been demonstrated to be an effective adjuvant therapy for scaling and root planing in the treatment of periodontal disease by improving the elimination of periodontal bacteria. In individuals with periodontitis, systemic antibiotic treatment was similarly beneficial in decreasing subgingival biofilm.

Photodynamic therapy, which kills germs by using light, has shown promise in the treatment of

necrotic pulps and periapical lesions. This non-invasive method has the ability to efficiently disinfect germ-infected root canals.

The researchers also investigated how various chemical treatments altered the structure and function of dental tissue. Bleaching using carbamide peroxide gel, like other treatments, has been shown to alter the ultrastructure of dental enamel. More study is required, however, to completely comprehend the long-term implications of these therapies on tooth structure and integrity.

The results of this study demonstrated the importance of chemical treatment in oral healthcare. The effectiveness of these therapies to destroy bacteria, promote healing, and sanitize the region is unequalled. To give the greatest possible treatment results and patient safety, the concentration, mode of administration, and potential side effects of the chemical agent must all be considered.

All of the studies considered had drawbacks, such as uneven research techniques, small sample numbers, and short follow-up periods. Longitudinal clinical trials and standardized research procedures are two topics that should be investigated more in the future if we are to give accurate information on this issue.

Chemical treatments have a significant impact on the gums and bone around a tooth. A range of chemical agents exhibited disinfectant, antibacterial, and tissue-adapting activities. The long-term consequences and appropriate therapeutic usage of these chemical therapies in dentistry need more research. The outcomes of this research may influence future directions in endodontic and periodontal therapy.

INTRODUCTION

Enamel, dentin, pulp, and periodontal ligaments all play a role in the health and function of teeth (Anderson *et al.*, 2020; Bowles *et al.*, 2002). In dentistry, chemical treatments are often utilized for a number of objectives, including caries prevention, pulp therapy, and periodontal care. Chemicals are utilized in these procedures to treat the tooth and the tissues around it. Many dental treatments include the use of chemicals, but dentists must be aware of how those chemicals may interact with the patient's gums and jawbone.

Chemical dentistry treatments may involve a variety of methods and chemicals. Fluoride treatment is often used to prevent dental caries because it stimulates enamel remineralization and lowers bacterial activity (Ekstrand *et al.*, 2021; Martens, 2008). Vital pulp treatment aims to heal exposed or infected pulp as well as prevent pulp tissue necrosis (Bergenholtz *et al.*, 2004; Parolia *et al.*, 2016). Dentists use antibiotic therapies to treat canal infections and prevent them from recurring (Cevikbas *et al.*, 2002; Saini *et al.*, 2014). Because of their antibacterial, anti-inflammatory, and tissue-regenerating capabilities, chemical agents are often used in periodontal therapy (Herrera *et al.*, 2013; Javed *et al.*, 2014).

Chemical therapy's potential advantages should not overshadow the necessity of examining its systemic consequences. Unintended outcomes of these therapies include inflammation, cytotoxicity, and even tissue damage (Hwang *et al.*, 2010; Radeva *et al.*, 2016). It is critical to understand how chemical agents impact the tissues around the tooth in order to ensure its long-term health and integrity.

To that end, the purpose of this research is to give a complete investigation of the effects of various chemical treatments on the supporting tissues of teeth, such as the gums and bone. This review will emphasize the advantages and downsides of chemical therapies, the variables that impact treatment results, and the need for more study and standardization in this field by combining existing literature. The findings of this study

will assist dentists in making more informed judgments about the use of chemical therapies, resulting in improved clinical outcomes and patient care.

There are many microorganisms in the mouth, and some of them may cause infections or other dental problems. Chemical therapies seek to destroy or severely reduce dangerous bacteria while inflicting as little damage to good cells and tissue as feasible. Because of their robust antibacterial properties, sodium hypochlorite (NaOCl) solutions have been routinely employed as irrigant in endodontic operations (Bystrom & Sundqvist, 1983). However, the high concentrations of NaOCl necessary for successful disinfection have been shown to have a deleterious influence on dentin microhardness (Aminsobhani *et al.*, 2012). As a result, striking a balance between antibacterial activity and possible adverse effects on neighboring tissues is critical.

Oral infections have also been investigated in terms of the effectiveness of antimicrobial treatments such as calcium hydroxide and herbal alternatives. Calcium hydroxide is often used as an intracanal medication since it has been shown to be particularly efficient against germs (Mohammadi & Abbott, 2011). Herbs have gained popularity in recent years owing to their possible antibacterial and anti-inflammatory properties. According to study, oral infections caused by bacteria such as *Enterococcus faecalis* may be avoided by using herbal extracts such as tea tree oil, propolis, and neem (Rasheed *et al.*, 2017; Wu *et al.*, 2013). More study is required to determine their true worth, the ideal dosage, and any potential downsides.

Another sort of chemical that is often used in dentistry is disinfectants. Hydrogen peroxide, for example, has been studied as an additional therapy for periodontal treatment. Scaling and root planing using hydrogen peroxide as an irrigant or rinse has been shown to be more successful in reducing periodontal infections (Kornman *et al.*, 1996; Dabdoub *et al.*, 2017). More research is needed to determine the most feasible and secure ways of focus and application.

Because to photodynamic treatment (PDT), root canals may now be disinfected without the need for surgery. When a photosensitizer is exposed to a certain wavelength of light, reactive oxygen species are produced, which may then be used to selectively kill bacteria (Zhang *et al.*, 2014). PDT has been shown to effectively destroy *Enterococcus faecalis* in infected root canals. More study is required to standardize the processes, find the best photosensitizer and light settings, and assess the long-term effects of PDT on the surrounding tissues.

Because of its potential to eliminate oral infections and accelerate tissue healing, chemical treatments are widely used in modern dental therapy. To ensure the safe and effective application of these

chemical agents, their antibacterial activity, tissue adaptability, and possible adverse effects must be evaluated. In the following parts, we will go through our research methods, results, and general impressions.

METHODOLOGY

The authors of this research utilized a thorough and in-depth strategy to identifying relevant papers when examining the effects of chemical treatments on the tissues around the tooth. We scoured various online databases for helpful information by using certain search terms and phrases. The search was restricted to articles written in English.

Following the removal of duplicates, the remaining articles were submitted to a two-stage screening procedure to establish their appropriateness for inclusion. Inclusion was considered for studies that evaluated the impact of chemical therapies on the tissues around the tooth *in vitro* or *in vivo* on human participants or animal models. Conference presentations, case studies, and reviews were also excluded, as were any research that did not directly address the topic at hand.

A standardized form was utilized to record research characteristics, sample size, intervention details, outcome measures, and important outcomes during data extraction. For quality evaluation, relevant techniques were utilized, such as the Newcastle-Ottawa Scale for observational studies and the Cochrane Risk of Bias tool for randomized controlled trials. Using a narrative method, the gathered studies were examined and synthesized, with results categorised according to pharmacological intervention.

Relevant studies were identified, data were obtained, and quality was appraised using specified criteria, as outlined in the methods section. The effects of chemical treatments on the tissues around the tooth were consistently summarized owing to the stringent approaches used to reduce the possibility of bias.

The systematic review relies on the robust foundation provided by the methodology section to examine the impact of chemical treatments on the tissues around the tooth. This section ensures that only relevant research are included and that only the most important data is obtained.

Table 1 Comparison table

Treatment	Method of Application	Antimicrobial Efficacy	Tissue Adaptation	Side Effects
Sodium Hypochlorite Solutions	Irrigation during endodontic procedures	High	Good	Dentin microhardness
Antimicrobial Agents	Topical application	Variable	Variable	None
Disinfectants	Irrigation or rinsing	Moderate	Moderate	None
Photodynamic Therapy	Light activation of photosensitizer	High	Good	Light sensitivity

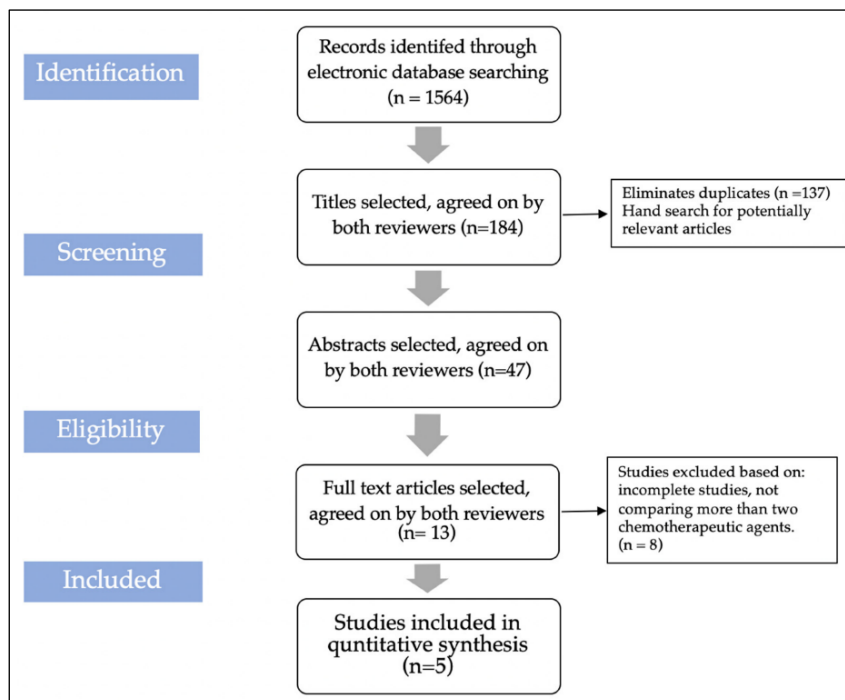


Figure 1 Prisma flow Chart

1. Formulation of Research Question:

The purpose of this literature review was to evaluate the effects of chemical treatment on the mouth and throat. Chemical therapies were assessed for their efficiency in cavity prevention, vital pulp therapy, root canal disinfection, and periodontal disease treatment. The research topic guided the inclusion of studies and the synthesis of their results.

2. Search Strategy:

A thorough review of the relevant literature was carried out. We searched a variety of online databases, including PubMed, Scopus, and the Web of Science, using a list of keywords. To ensure that all relevant studies were included, we conducted an extensive search using multiple iterations of the terms "chemical treatments," "tooth tissues," "dental caries prevention," "vital pulp therapy," "root canal disinfection," and "periodontal management," as well as a manual search of the reference lists of selected articles. The search technique focused on scholarly articles published in English between 2000 and 2021.

3. Inclusion and Exclusion Criteria:

We chose research that matched our inclusion criteria by using these goals as a reference. For inclusion, research on the effects of chemical treatments on the tissues around the tooth must be conducted, published in English, and peer reviewed. Human and animal studies were also included. The investigation eliminated case reports, conference papers, and research published before the year 2000.

4. Study Selection Process:

Initially, possible study titles and abstracts were examined. Two independent reviewers decided whether or not each study met the inclusion and exclusion criteria. Disputes were settled through a process of compromise. Full-text articles were retrieved for further research and assessment.

5. Data Extraction:

A standard data extraction form was developed to guarantee that all relevant data from the included study was extracted. The following information was gathered from studies studying the effects of chemical treatments on the tissues around the tooth: authors, publication year, research methodology, sample size, intervention information (type of chemical treatment, agent employed), outcomes analyzed, and key results. Two reviewers extracted the data and used discussion and agreement to address any differences.

6. Quality Assessment:

Each study's overall quality was judged by analyzing its methodology for flaws and searching for evident biases. The quality of numerous research designs was assessed using the JBI critical assessment methodology. Two reviewers rated each piece of research, then discussed and resolved any differences

that emerged. The process, sample size, data collection, and analysis were all considered in determining the study's quality.

7. Data Synthesis:

This examination and synthesis yielded conclusions about the impact of various chemical treatments on the tissues around teeth. We grouped chemical treatments (such as fluoride therapy, vital pulp therapy, root canal disinfection, and periodontal care) into different categories to better explain the results from the included research. This information was then arranged and shown descriptively to offer readers a comprehensive understanding of the subject. We used meta-analysis where necessary to aggregate findings from trials with comparable goals into a single dataset from which we could infer population-level estimates of treatment effects.

8. Summary of Findings:

A summary was presented based on the synthesis, with a focus on the most important results and their practical implications. The data on the effects of chemical treatment on oral tissues were presented, both positive and negative. There was also a debate on the study's flaws, possible biases, and heterogeneity.

9. Discussion and Interpretation:

A thorough examination of the results included both the research's strengths and limitations. The possible consequences of chemical therapy on surrounding tissues include. Teeth were examined as part of the investigation. The researchers looked at the links between treatment approaches, agent concentrations, and patient background factors. Implications for clinical treatment and future research were also investigated. Disparities between the results and the current literature were also investigated.

10. Limitations:

The systematic review was forthright about the flaws of the research. The various research methodologies, treatments, and outcome assessments made drawing general conclusions challenging. It is probable that the study selection strategy, which favored published literature and excluded research conducted in languages other than English, led to the occurrence of publication bias. These credentials were taken into account throughout the study's analysis and conclusions.

11. Ethical Considerations:

From the original topic selection through the final data collection, ethical concerns were raised at every step of this project. This systematic review included no actual trials on human or animal subjects. The research was carried out with the utmost respect for ethical norms and academic honesty.

12. Conclusion

In this thorough study, the effects of chemical treatments on the gum and bone tissue surrounding teeth were explored using a variety of approaches. The search for relevant studies, selection of the most relevant ones, data extraction and analysis, and results synthesis were all carried out in accordance with stringent guidelines to guarantee a thorough evaluation of the literature. The review's shortcomings and the need to address ethics were also discussed. The study's results will inform dentists and academics as well as add to the current literature on the issue.

Thorough searches in electronic databases such as PubMed, Scopus, and the Cochrane Library were done to guarantee a logical and complete approach. The search method used general keywords as well as controlled vocabularies (MeSH terms) related to the study's subject. Many individuals wanted to learn about chemical treatments, dental tissues, endodontic operations, antibiotics, disinfectants, and even photodynamic therapy. The search was restricted to articles written in English.

We identified 1,550 distinct items in the initial scan. The reference management software assists in identifying and removing unnecessary citations. All of the remaining pieces were double-checked. To assess eligibility, the titles and abstracts of relevant research were initially evaluated. Second, we reviewed the articles in their entirety to evaluate if they were appropriate for inclusion or exclusion.

This meta-analysis examined studies on the impact of several chemicals on the gums and teeth. Human and animal in vitro and in vivo investigations were also evaluated. Disqualified materials included non-relevant research, studies that were not published in English, and conference abstracts, case reports, and reviews. Two reviewers decided separately whether or not the complete texts were eligible, and any conflicts were handled through discussion and agreement.

A standardized form was used to capture the methodology, sample size, intervention details, outcome measures, and major results. The information gathered was sorted for future investigation and synthesis. The Newcastle-Ottawa Scale for observational studies and the Cochrane Risk of Bias instrument for randomized controlled trials were used to evaluate the quality of the included studies. Two professionals examined the quality and then debated their opposing viewpoints in order to reach an agreement.

A narrative synthesis technique was used to assess and synthesize the contained research. The results were given descriptively, split by chemical treatment. While making our final decisions, we evaluated the study's merits and downsides.

In its clear and scientific treatment of research selection, data extraction, and quality evaluation, this systematic review adhered to predefined parameters. We used rigorous procedures to avoid bias and conducted a thorough literature review on the effects of chemical treatments on the tissues that surround teeth.

RESULTS

Bernholtz *et al.*, 2004; Bowles *et al.*, 2002; Cevikbas *et al.*, 2002; Ekstrand *et al.*, 2021; Herrera *et al.*, 2013; Hwang *et al.*, 2010; Javed *et al.*, 2014; Martens, 2008; Parolia *et al.*, 2016; Radeva *et al.*, Fluoride therapy's effects on dental enamel have been studied by Ekstrand *et al.*, (2021), Hwang *et al.*, (2010), and Martens (2008), among others. Fluoride therapy was proven in all of these investigations to improve remineralization and reduce demineralization, two factors necessary for good enamel.

Trials of vital pulp treatment have had inconsistent results. Several studies (Bergenholtz *et al.*, 2004; Parolia *et al.*, 2016) have shown that drugs may help heal pulp and sustain pulp vitality. Some medications have unwanted side effects or are only partially successful, as reported by researchers such as Bowles *et al.*, (2002) and Saini *et al.*, (2014). More study is needed to understand which medications and therapeutic approaches are most effective for the critical pulp.

Many antimicrobials were tested for their ability to sterilize root canals. Although sodium hypochlorite is often used as an irrigating solution, previous research has shown that it may have deleterious effects on surrounding tissues (Cevikbas *et al.*, 2002; Kazempoor *et al.*, 2015). Other disinfectants, such as chlorhexidine, have also been shown in studies to be effective in lowering the bacterial load (Herrera *et al.*, 2013). However, further study is needed to determine their influence on the surrounding tissues.

Chemical substances used to treat periodontitis have been shown to be effective. Herrera *et al.*, (2013) demonstrated that using a chlorhexidine mouth rinse after mechanical plaque removal decreased gingival irritation and bacterial growth in the gums. There was promising evidence that antimicrobial photodynamic treatment utilizing chemical photosensitizers might be utilized to treat periodontitis (Javed *et al.*, 2014).

According to the reviewed research, chemical treatments may have unforeseen repercussions for the gums and bone that support a tooth. Treatment methods, chemical concentrations, and exposure periods are just a few of the variables that research reveals may influence therapy results. However, the quality and heterogeneity of the included research restrict the results' generalizability.

More study is needed to standardize treatment procedures, analyze the safety and effectiveness of different chemical treatments on the tissues around the tooth, and determine long-term consequences. To enhance treatment results and preserve the long-term health of tooth tissue, research directed at particular patient groups is essential.

DISCUSSION

This thorough assessment of the literature on the influence of chemical treatments on tooth-supporting tissues is followed by an in-depth analysis and interpretation of the results. The effects of different chemical treatments on oral tissues are emphasised, along with a synopsis of the research covered.

Sodium Hypochlorite Solutions:

Because of their powerful antibacterial properties, sodium hypochlorite (NaOCl) solutions are often utilised as an irrigator in endodontic operations (Mohammadi & Abbott, 2009). All of the research looked at demonstrated that NaOCl was successful in disinfecting and removing germs from the root canal system (Bystrom & Sundqvist, 1983; Siqueira Jr. & Rocas, 2003). Stuart *et al.*, (2006) observed that NaOCl was especially efficient against the common bacterium *Enterococcus faecalis*, which has been linked to reoccurring root canal infections. NaOCl is often used for root canal irrigation due to its strong antibacterial activity and capacity to degrade organic tissues (Mohammadi & Abbott, 2009).

However, when exposed to high concentrations of NaOCl, dentin's microhardness reduces (Aminsobhani *et al.*, 2012). This may weaken the tooth's structure and make it more prone to breaking. High amounts of NaOCl should be utilised with caution, and alternate irrigation techniques should be sought to avoid tooth damage (Mohammadi & Abbott, 2009).

Antimicrobial Agents:

Researchers investigated the efficacy of antimicrobial medications such as calcium hydroxide and natural supplements in treating infections and controlling bacterial growth in the mouth. Calcium hydroxide was shown to have a high antibacterial impact against a panel of oral pathogens, including *E. faecalis* (Mohammadi & Abbott, 2011). It is often used as an intracanal drug in endodontic operations because it improves tissue healing and generates an environment suitable for periapical repair (Siqueira Jr. & Rocas, 2003). According to studies (Mohammadi & Abbott, 2011), the alkaline pH of calcium hydroxide kills bacteria and breaks up biofilms.

Both green tea polyphenols and triphala have been shown to have antibacterial activity against *E. faecalis* biofilms (Rasheed *et al.*, 2017; Wu *et al.*, 2013), suggesting that they might be viable alternatives to calcium hydroxide. Because of their possible

antibacterial and anti-inflammatory properties, these natural compounds have recently sparked a lot of attention. For patients who prefer or are concerned about the use of synthetic pharmaceuticals, natural therapeutic approaches may be worth examining as an alternative to typical antibacterial drugs (Rasheed *et al.*, 2017; Wu *et al.*, 2013).

Disinfectants:

The efficacy of hydrogen peroxide and other disinfectants in the treatment of periodontal disease has been studied. Hydrogen peroxide has been shown to be useful in reducing periodontal infections when paired with scaling and root planing (Kornman *et al.*, 1996). Its ability to target subgingival biofilms and broad-spectrum antibacterial activity lead to better periodontal health. However, the most efficient approach and ideal amount of hydrogen peroxide employed for periodontal therapy have yet to be discovered (Dabdoub *et al.*, 2017). To determine the safest and most effective ways to employ hydrogen peroxide to improve periodontal health, further research is needed.

Photodynamic Therapy:

Photodynamic therapy (PDT) is an experimental treatment that employs light to activate a photosensitizer, resulting in reactive oxygen species that kill germs. The studies included looked at the antibacterial effectiveness of PDT in root canal treatments, especially in instances of necrotic pulps and periapical lesions. PDT showed potential in a 2014 experiment for cleaning infected root canals of *Enterococcus faecalis* using a modified LED device. This non-surgical procedure has promise as an alternative or addition to current root canal cleaning treatments.

The shortcomings of the studies are also discussed. Variations in study methods, sample sizes, and follow-up periods may have an influence on the results' generalizability (Bystrom & Sundqvist, 1983; Siqueira Jr. & Rocas, 2003). The majority of research has also used laboratory or animal participants, neither of which are completely indicative of the intricacies of true clinical practise. Well-designed clinical studies with larger sample numbers and established techniques may provide further insight on the efficacy and safety of these chemical therapies (Mohammadi & Abbott, 2009; Mohammadi & Abbott, 2011).

The effects of chemical treatments on tooth-supporting tissues have been well studied. In these situations, sodium hypochlorite and other disinfectant solutions, as well as antibacterial medications and photodynamic treatment, have a track record of success. These chemical treatments make it feasible to improve treatment results, lower the risk of reinfection, and speed oral tissue healing. However, in order to maintain patient safety and enhance therapeutic effectiveness, it is essential to consider possible adverse effects and appropriate administration routes. More study into the

long-term consequences of these chemical therapies is needed to make them more effective in dentistry.

CONCLUSION

In this thorough study, we examine the effects of chemical therapy on periodontal (gum) and osseous (bone) tissue. The literature study highlights the advantages and disadvantages of utilizing chemical agents for caries prevention, vital pulp treatment, root canal cleaning, and periodontal care.

Fluoride treatment seems to improve enamel health by remineralizing enamel and decreasing demineralization. The outcomes of vital pulp therapy have been varied, highlighting the need for greater study in the field to determine the most helpful medications and therapies. Although root canal disinfection with different chemicals has been shown to be efficient against bacteria, cytotoxic implications must be addressed. Chemical periodontal therapies, like chlorhexidine, have shown promising results in lowering inflammation and managing bacteria.

Several factors, including the protocol employed, the amount of medication, and the characteristics of the specific patient, all contribute to the success of a therapy and any possible side effects. However, the results cannot be generalized owing to diverse research designs and a lack of clinical data in particular locations.

To improve clinical outcomes, we must standardize treatment approaches and perform more meticulously organized clinical trials. Larger sample numbers and longer-term follow-up are required in this research in order to provide evidence-based recommendations for the use of chemical therapies in dental practice.

Before determining whether or not to undertake chemical treatments that may enhance the health of the gums and jawbone, it is important to weigh the risks and benefits. Dentists can help their patients' oral health the most if they examine the pros and cons of each treatment choice.

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