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A Journal of Advanced Dentistry

Pioneering Progress in Advanced Dentistry : A Visionary Path Forward

As the Executive Editor of Journal of Advanced Dentistry Updent, it is my privilege to share this editor-ial at a time when the field of dentistry stands at the cusp of remarkable transformation. The journey of modern dentistry has been nothing short of extraordi-nary, character-ized by innovation, scientific rigor, and an unwavering commitment to improving oral health and overall well-being. Yet, as we step further into the 21st century, the question arises: how do we harness the opportun-ities of this new era to further revolutionize our field?

This editorial seeks to reflect on the current state of advanced dentistry, highlight emerging challenges, and explore the limitless potential that interdisciplinary collabor-ation, technology, and research innovation bring to our profession.

The Evolution of Advanced Dentistry

Dentistry has evolved dramatically from its rudimentary beginnings to a sophisticated, patient-centered discipline. What was once primarily reactive, focused on pain manage-ment and tooth restoration, is now a proactive, prevention-driven science. Today's dentistry encompasses aesthetics, functionality, and systemic health, supported by cutting-edge advancements in biomaterials, regenerative medicine, and digital technology.

The introduction of computer-aided design and manufac-turing (CAD/CAM), 3D printing, and minimally invasive techniques has redefined how we deliver care. Dentists are now equipped with tools that not only improve precision but also enhance patient comfort and outcomes. From personal-ized aligners to custom implants, the potential for bespoke dentistry is becoming a reality.

Challenges in Contemporary Dentistry

Despite these advancements, our field faces several pressing challenges that demand collective attention and action:

1. Accessibility and Equity

The global disparity in oral healthcare access remains a significant concern. While urban areas benefit from cutting-edge practices and technologies, rural and underserved populations often lack basic dental care. Bridging this gap requires systemic reform, public health initiatives, and the development of cost-effective solutions.

2. Integration of Oral and Systemic Health

The interconnection between oral health and systemic diseases such as diabetes, cardiovascular conditions, and even Alzheimer's disease is increasingly evident. However, the integration of dentistry into general healthcare systems lags behind. Collaborative efforts between dental and medical professionals are essential to create a holistic approach to patient care.

3. Technological Adaptation

While technology promises to revolutionize dentistry, its rapid pace presents a dual-edged sword. The steep learning curve, high costs, and the need for continuous training can be barriers for practitioners. Ensuring that innovations are acce-ssible and practical is crucial.

4. Environmental Sustainability

As healthcare professionals, we must acknowledge our environmental footprint. From single-use materials to energy-intensive practices, dentistry has a responsibility to adopt sustainable practices. Embracing green dentistry is not just an ethical imperative but also a professional one.

The Role of Research and Innovation

The bedrock of progress in dentistry lies in robust, innova-tive research. As stewards of evidence-based practice, it is incumbent upon us to foster a culture of inquiry, critical analysis, and knowledge dissemination. The research priorities of the future should focus on:

Regenerative Dentistry

The dream of regrowing natural teeth is no longer confined to science fiction. Advances in stem cell research and tissue engineering are paving the way for regenerative solutions that could transform how we treat tooth loss and damage.

Artificial Intelligence and Big Data

AI holds the potential to revolutionize diagnostics, treat-ment planning, and patient management. From predicting disease progression to customizing treatment plans, data-driven dentistry is set to redefine standards of care.

Biomaterials and Nano-dentistry

The development of biomimetic materials and nanotechn-ology is enabling more durable, aesthetic, and biocompatible solutions. These innovations promise not only better

outcomes but also more efficient procedures.

Public Health and Preventive Strategies

Research into public health initiatives, behavioral interventions, and preventive measures is essential to address the root causes of oral diseases. This requires collaboration with policymakers, educators, and community leaders.

The Power of Interdisciplinary Collaboration

Dentistry does not exist in isolation. The challenges we face and the advancements we aspire to achieve require partnerships across disciplines. Collaborations with biomedical engineers, data scientists, and public health experts can unlock new dimensions of innovation.

Moreover, the integration of patient perspectives into the research and clinical process is becoming increasingly important. Co-creation of solutions ensures that advancements align with the needs, preferences, and experiences of those we serve.

Embracing Diversity and Inclusion

As we shape the future of dentistry, diversity and inclusion must be central to our vision. A diverse workforce enriches the profession, bringing varied perspectives and approaches to problem-solving. Encouraging representation from different genders, ethnicities, and socioeconomic backgrounds strengthens our ability to meet the diverse needs of patients worldwide.

The Role of Journal of Advanced Dentistry Updent

At Journal of Advanced Dentistry Updent, our mission is to be a beacon of knowledge, fostering the dissemination of groundbreaking research and best practices. As a platform for thought leaders, researchers, and clinicians, we are committed to driving meaningful conversations that shape the trajectory of advanced dentistry.

Through rigorous peer review, cross-disciplinary dialogue, and a focus on practical application, we aim to bridge the gap between research and clinical practice. Our journal is not merely a repository of knowledge but a catalyst for innovation and change.

A Call to Action

As we navigate this exciting period of transformation, I urge all stakeholders in the dental community-academicians, practitioners, researchers, and students-to embrace a mindset of curiosity, collaboration, and responsibility. Let us:

Innovate with Purpose: Develop solutions that are not only advanced but also accessible, ethical, and sustainable.

Educate for the Future: Equip the next generation of dental professionals with the skills and knowledge to thrive in a rapidly evolving landscape.

Advocate for Change: Work towards policies and practices that promote oral health equity and integration into broader healthcare systems.

Conclusion

The future of advanced dentistry is bright, brimming with possibilities that were once unimaginable. Yet, with great potential comes great responsibility. It is our duty to ensure that the advancements we make are inclusive, sustainable, and focused on improving lives.

As we continue to explore new frontiers, let us remain steadfast in our commitment to excellence, innovation, and compassion. Together, we can build a future where oral health is a universal right, not a privilege-where dentistry is not just a profession but a beacon of hope and healing.

Thank you for your dedication to advancing our field. I invite you to engage with Journal of Advanced Dentistry Updent as we chart this visionary path forward. Let us inspire, collaborate, and innovate-together.

Dr. Anand A. Tripathi

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Pathogen Patrol : Antibiotic Management in Oral and Maxillofacial Interventions

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Abstract

Antibiotics play a critical role in the management of infections and prophylaxis in oral and maxillofacial surgery. The increasing emergence of antibiotic resistance and the need for effective infection control strategies necessitate a review of current practices and guidelines. This review aims to provide a comprehensive overview of the use of antibiotics in oral and maxillofacial surgery, including their indications, selection criteria, and the impact of antibiotic stewardship on patient outcomes. A Prophylactic antibiotics are commonly recommended for certain high-risk procedures to prevent surgical site infections, with guidelines emphasizing the timing, choice, and dosage of antibiotics. Therapeutic use of antibiotics is indicated for managing established infections, with considerations for local bacterial resistance patterns and patient-specific factors. The review highlights the increasing concern over antibiotic resistance and the need for tailored approaches to minimize unnecessary antibiotic use.Effective antibiotic use in oral and maxillofacial surgery requires a balanced approach that considers both prophylactic and therapeutic needs while addressing the risks of resistance. Adhering to updated guidelines and incorporating antibiotic stewardship principles can optimize outcomes and contribute to broader public health efforts.

Introduction

The utilization of antibiotics is a fundamental aspect of surgical, medical, and dental practices. Antibiotics are employed either as a preventive measure against infections or as a treatment for existing infections. It seems that the very same life-saving drugs that were once celebrated in the past are now largely implicated in the emergence of more resistant strains of bacteria and viruses today.

The solution to antibiotic resistance is multifaceted and involves factors related to bacteria, patients, and healthcare providers. Bacteria possess an incredible ability to adapt, potentially becoming resistant when exposed to antibiotics at sub-lethal levels.

Given this complex landscape, it's imperative that we reassess the value of antibiotics and consider a more rational approach to antibiotic therapy moving forward[1].

Classification of antibiotics

Antibiotics can be classified in several ways:

1. Chemical Structure: Antibiotics can be categorized based on their chemical structure, such as penicillins, cephalosporins, macrolides, tetracyclines, and fluoroquino-lones.
2. Mechanism of Action: Antibiotics can be classified based on how they work to kill or inhibit the growth of bacteria. For example, some antibiotics target bacterial cell walls (e.g., penicillins), while others interfere with protein synthesis (e.g., tetracyclines) or nucleic acid synthesis (e.g., fluoroquino-lones).
3. Spectrum of Activity: Antibiotics can be broad-spectrum, meaning they are effective against a wide range of bacteria, or narrow-spectrum, targeting specific types of bacteria.
4. Source: Antibiotics can also be classified based on their source of origin. They can be derived from natural sources, such as fungi (e.g., penicillin), bacteria (e.g., streptomycin), or synthetic sources, where

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they are chemically synthesized in the laboratory.

This classification system helps to organize and understand the diverse range of antibiotics.

Antibiotic resistance

Misuse of antibiotics is prevalent. The surge in antibiotic-resistant bacteria primarily stems from their extensive utilization across medical practices, animal husbandry, and agricultural settings. Physicians frequently prescribe antibiotics upon patient request, even when unnecessary, such as in cases of viral or non-bacterial infections. This unwarranted antibiotic consumption directly accelerates the emergence of resistant bacterial strains.

Despite being prescription-only medications, antibiotics are frequently mismanaged. Patients frequently neglect to complete the entire treatment regimen. Consequently, disease-causing agents are exposed to suboptimal doses, which often fail to eradicate the infecting bacteria entirely. The surviving bacteria, typically the most resistant to treatment, are allowed to multiply unchecked, potentially leading to subsequent infections that are more challenging to treat[2].

Antibiotic Prophylaxis

Wound infections following surgery pose a significant risk to patients' health. Employing antibiotics before and during surgery has become a crucial aspect of standard medical practice across various surgical procedures. This approach has led to a decreased incidence of postoperative infections when appropriate prophylactic measures are adhered to.

Penicillin

Penicillin, a broad-spectrum group of agents, encompasses penicillin G, penicillin V, oxacillin, dicloxacillin, naficillin, ampicillin, amoxicillin, ticarcillin, and piperacillin. These agents are bactericidal and represent the most valuable antimicrobial agents (AMAs) for treating orofacial infections, whether of odontogenic, traumatic, or post-surgical origin. Oral penicillin undergoes partial inactivation by gastric acid. Through slight modification of the side chain, penicillin V (phenoxy methyl penicillin) is produced, which is orally administered and resistant to gastric acid breakdown, thereby ensuring adequate serum levels.

Oral penicillin is indicated for minor oral/dental infections and minor soft tissue infections caused by susceptible organisms.Side effects of penicillin are relatively common, occurring in 1% to 15% of patients, with allergy being the most concerning. Fatal reactions may occur in 0.002% of patients. The most frequent allergy manifestation is a maculopapular rash, followed by urticaria, drug fever, bronchospasm, serum sickness, and exfoliative dermatitis[3].

Antibiotic Prophylaxis

The antibiotics have been developed in past 50 years has significant impact on the health of human race. The antibiotics in oral surgery are mainly used for two purposes.

1) Antibiotic prophylaxis to prevent infections.

2. Antibiotics in treatment of infections.

The principle of prophylactic antibiotics

1. Assessment of procedure risk: Antibiotic prophylaxis should be reserved for oral surgical procedures that carry a significant risk of postoperative infections. This assessment considers factors such as the invasiveness of the procedure, the presence of preexisting infections, and the patient's overall health status.
2. Selection of appropriate antibiotics: The choice of antibiotic should be based on the likely pathogens involved in the surgical site and their susceptibility patterns. This ensures that the selected antibiotic provides adequate coverage against the potential pathogens while minimizing the risk of unnecessary broad-spectrum antibiotic use.
3. Proper administration: Antibiotics should be administered in a manner that achieves optimal tissue levels at the time of incision while minimizing the duration of antibiotic exposure. This involves timing the administration of antibiotics appropriately before surgery and adhering to recommended dosing regimens. The goal is to achieve high antibiotic concentrations in the surgical site during the period of greatest risk for infection.
4. Comprehensive infection prevention: While antibiotic prophylaxis is an important component of infection prevention, it should not be relied upon as the sole strategy. Effective infection prevention also involves reducing the number of bacteria in the surgical wound through meticulous surgical technique, proper wound irrigation, and the use of antimicrobial rinses. Additionally, enhancing host defenses through measures such as optimizing nutrition, controlling systemic diseases, and promoting wound healing can further reduce the risk of postoperative infections[3].

Selection and Administration of Antibiotic

The appropriate antibiotic selection should be made for prophylactic purposes in particular patient. This selection is made based on certain requirements.

The antibiotics chosen by the surgeon must be effective against the bacteria that are most likely to cause infection following surgical procedure. It need not to be able to eliminate every pathogenic bacteria encountered.

The selected antibiotic should be used in right dose, right route, and right time and for right duration. The above approach is known as rational antibiotic therapy. It makes antibiotic maximally effective and reduces the development of bacterial resistance.

Correct time of administration of antibiotics is considered. To be maximally effective antibiotic should be in the tissue at the time of contamination occurs. As a general guideline antibiotics should not be given on the previous day or in the patient's room before arrival in the operating room. The antibiotic should be administered intravenously/ intramuscularly 30 minute before the placement of incision at twice the therapeutic dose. For penicillin the dose is 2 million

units and for cefazolin it is 1g. This dose adequately provides coverage for up to 4 hours (As a general rule prophylactic antibiotic dosage interval should be one half of the usual therapeutic interval). So if the procedure is prolonged, however it is advisable to administer additional doses every 4 hours until the surgery is completed.

Specific application of antibiotic use, in Oral and Maxillofacial surgery.

Dentoalveolar surgery

Although the oral microbiological flora contaminates intraoral extractions wounds and surgical wounds, the infection rate is very low. This is due to excellent blood supply to oral tissue. It is unnecessary to use prophylactic antibiotics to prevent infection in healthy individual.

Prophylactic antibiotics are indicated in following scenario

If the procedure involves the maxillary sinus OR nasal cavity, can result in cross contamination with new organisms.

If the patient host defense mechanism is compromised e.g.; Poor nutritional states, complicating medical problems, presence of necrotic tissue / foreign body and decreased blood supply to the region.

Patients who have received organ transplants may be on long-term immunosuppressive therapy and patients who are receiving chemotherapy for cancer should have their surgery done under preventive antibiotic coverage.

Patients who have diagnosed metabolic disease (diabetes mellitus) that is well controlled do not require antibiotic therapy. However patients with uncontrolled metabolic disease (fluctuation in glucose level, under insulin therapy) prophylactic antibiotic cover indicated.

Patient undergoing chemotherapy antibiotic prophylaxis is considered if invasive dental procedure is carried out.

Patient with AIDS, in the absence of bacterial infection does not generally require antibiotic prophylaxis. Antibiotics considered in case where more chances of bacteremia may occur (In case of extraction of teeth with abscess).

AHA/ADA reconsiders use of antibiotic coverage for chronic intravenous drug abusers and for patients who have undergone splenectomy[4].

Impacted third molar surgery

In the context of impacted third molar surgery, many practitioners routinely prescribe antibiotics either before or after the procedure. However, research shows that this practice does not significantly reduce the rate of postoperative infections, which are relatively rare. Common postoperative infections include alveolar osteitis (dry socket) and facial space infections. Studies indicate that administering antibiotics preoperatively or postoperatively does not notably lower the risk of these complications.

Although there have been isolated cases of severe facial space infections following third molar removal, their occurrence is too rare to justify the routine use of prophylactic antibiotics. Antibiotics should be reserved for patients with significant medical risk factors for infection. For these patients, antibiotics should be given immediately before surgery and continued for 3 to 5 days afterward to ensure adequate protection. This targeted approach helps avoid the unnecessary use of antibiotics and reduces the risk of antibiotic resistance and other adverse effects.

Dental Implants

Studies conducted by Peterson and Larsen on the effects of antibiotics on the infection rate after implant placement, although lacking a control group, concluded that preoperative antibiotics were effective in preventing postoperative infections. However, other better-controlled studies found no significant difference in postoperative infections or implant failures between patients who received antibiotics and those who did not.

More recent large multicentric studies analyzed implant failures and found a significant reduction in failures up to stage 2 surgery when high-dose preoperative antibiotics were administered. These findings were confirmed in a follow-up study at 36 months within the same patient population, showing a failure rate of 4.6% versus 10%. These studies demonstrated the benefit of using prophylactic antibiotics in dental implant patients.

Orthognathic Surgery

Orthognathic surgery performed via an extraoral approach is generally considered a clean procedure, and prophylactic antibiotics are not necessary unless there is an anticipated communication with the mouth. In contrast, intraoral procedures and surgeries involving the maxillary sinus and nasal passages are classified as clean-contaminated wounds. Short-term antibiotic use in these cases has been shown to reduce postoperative infection rates.

One study demonstrated that a 5-day antibiotic regimen was more effective than a 1-day regimen in reducing infections. However, Aboobaker noted that the observed difference was due to variations in the criteria used to establish wound infections.

Maxillofacial fractures

Patients with condylar process fractures, whether treated by open reduction or closed reduction requiring an extraoral incision, do not need prophylactic antibiotic coverage. Fractures in non-tooth-bearing areas that are not in communication with the mouth are considered clean wounds and do not require antibiotic therapy. However, in patients with compound fractures of the facial skeleton, antibiotics are necessary to prevent infection at the fracture sites. Approximately 50% of fractures in patients who do not receive antibiotics become infected, but the administration of antibiotics reduces this rate to less than 10%.

Most of these studies administered antibiotics both preoperatively and for an extended period postoperatively. However, more recent investigations have shown that short-term antibiotic prophylaxis is equally effective in preventing infections in these situations.

Mid-facial fractures involving the mouth, nose, or paranasal sinuses require antibiotic coverage, though some studies suggest it may not be necessary. One of these studies was not well controlled, and others had a relatively small number of cases, leaving the issue unresolved. Therefore, it is reasonable to consider such wounds as clean-contaminated and to use preoperative prophylactic antibiotics.

Patients with traumatic injuries involving the oral mucosa, gingiva, or tongue do not require prophylactic antibiotics because these wounds, despite being contaminated, generally heal without infections. Simple extraoral lacerations from relatively clean objects that are closed within 4 hours also have a low infection rate and do not require prophylactic antibiotics[5].

Extraoral soft tissue injuries caused by blunt force, gunshot wounds, bites, and those involving orocutaneous communication are considered clean-contaminated or contaminated wounds, and patients should receive pretreatment antibiotic prophylaxis. If these wounds are extremely dirty, postoperative therapeutic antibiotics should also be administered.

Major head and neck surgery

Several studies and researchers support the use of preoperative antibiotics for patients undergoing major surgical procedures in the head and neck region, such as oncologic and reconstructive surgeries. However, the duration of postoperative antibiotic use remains a topic of debate. Several studies have shown that extending prophylactic antibiotics beyond one day after surgery offers no additional advantage unless there are specific complications, such as the presence of packs or drains in the wounds, an inability to achieve primary closure, or prolonged leakage of saliva into the wound.

Antibiotic in head and neck infections

Oral and maxillofacial surgeons frequently encounter infections as part of their everyday practice. These infections can be odontogenic, sinus infections, osteomyelitis, or fungal infections. These conditions not only cause pain, swelling, and severe inflammation but can also spread to the central nervous system (CNS) and cause respiratory difficulties, potentially leading to life-threatening situations. Therefore, timely and deliberate efforts to establish debridement and drainage, along with the selection of appropriate antibiotic therapy, are crucial for effective management by clinicians.

Odontogenic infections are the most commonly occurring infectious processes in oral and maxillofacial practice. Over the past four decades, significant changes have occurred in the use of antibiotics and antimicrobials for managing these infections. The decision to use antibiotics is based on several factors. The clinician must first diagnose the cause of the infection and determine the appropriate dental treatment to reduce or control the infectious process. It is also crucial to understand the mechanism of antimicrobial resistance, the potential problems it poses, and the means of overcoming it before selecting an appropriate antibiotic therapy[5].

Indications For Use of Antibiotics

Antibiotic therapy should be viewed as a supplementary measure to dental treatments and should never be relied upon as the sole first-line care approach. Pain alone or localized swellings generally do not warrant antibiotic treatment. Conditions such as pulpitis, apical periodontitis, draining sinus tracts, or localized swellings can often be effectively managed through endodontic procedures without the need for antibiotics.

In cases where the pulp is inflamed or infected, the compromised circulation within the pulp limits the effectiveness of antibiotics, as they rely on the vascular system to reach bacteria in therapeutic concentrations. Therefore, endodontic treatment, which involves thorough debridement of the root canal system to remove bacteria and their byproducts, is essential for effectively eliminating the infection, reducing inflammation, and promoting healing. Additionally, swelling can be drained through the tooth or via soft tissue incision, which stimulates healing, relieves pressure, improves circulation, and eliminates bacteria. Whenever possible, removing the underlying cause of the infection is crucial for successful treatment outcomes.

Antibiotics are warranted when systemic signs of involvement are evident. Clinical indicators such as fever, malaise, lymphadenopathy, or trismus suggest potential spread of infection, signaling the need for antibiotics in such cases. The selection of antibiotics should be guided by an understanding of the usual causative microorganisms.

Patients with compromised host defense mechanisms may require antibiotic therapy in conjunction with dental treatment. This ensures effective management and prevention of further complications, considering their heightened susceptibility to infections6.

Antibiotics in Pregnancy

Penicillins, cephalosporins, erythromycin, and clindamycin cross the placenta, providing therapeutic effects for both the fetus and the mother, and are not associated with congenital defects. Among macrolides, clarithromycin is a class C drug with uncertain safety. In the penicillin group, ticarcillin should be avoided. Aminoglycosides may cause fetal toxicity and nephrotoxicity. Tetracycline, if given after five months of gestation, can result in permanent discoloration of fetal teeth, maternal liver toxicity, and congenital defects; it is a category D drug and should be avoided during pregnancy.

The use of metronidazole during pregnancy is controversial. It is carcinogenic in rodents, but such effects have not been proven in humans. It may be used in the second and third trimesters and is classified as a category B drug.

Sulfonamides administered in the third trimester or close to delivery can persist in the blood for 2 to 3 days after birth and are associated with jaundice, hemolytic anemia, and kernicterus in newborns, so they should be avoided during the third trimester. Vancomycin is listed as an FDA category C drug, with controversy regarding its potential for fetal ototoxicity

and nephrotoxicity. The safety of fluoroquinolones during pregnancy has not been established.

Blood volume and creatinine clearance increase in pregnant patient. This can lead to a lower serum concentration of antibiotics in pregnant patient when compared with non-pregnant patients. Therefore in critical infections, serum level of antibiotics may need to be monitored and compensatory adjustments may be necessary[6].

Empirical antibiotic of choice in head and neck infections

1. **Odontogenic Infections**

   Empiric antibiotics are administered before culture and sensitivity test results are available; specific antibiotic therapy is then selected based on these results. Due to the increase in penicillin resistance and the failure of penicillin therapy observed in a study, clindamycin is recommended as the empiric antibiotic of choice for odontogenic infections serious enough to require hospitalization. A loading dose of 600 mg should be administered approximately 1 hour before surgical therapy begins, followed by 300 mg every 6 hours for the duration of the infection.

   Penicillin resistance has not yet become a problem in outpatient dental infections. Penicillin V remains the antibiotic of choice for outpatient odontogenic infections. A loading dose of 2000 mg penicillin VK should be administered approximately 1 hour before surgical therapy begins, followed by 500 mg every 6 hours. If the patient does not respond to penicillin within 48 hours, metronidazole may be added at a dose of 500 mg every 8 hours.

   The duration of antibiotic therapy for managing odontogenic infections is controversial. Previously, it was recommended to continue antibiotic therapy for 2-3 days after the symptoms subsided. However, due to concerns about developing antibiotic resistance, recent studies suggest that antibiotics can be safely discontinued once the symptoms subside, as the host defenses have gained control of the infection. Nevertheless, treatment of severe infections in immunocompromised patients may require a longer duration.

   Macrolides are no longer considered an empiric antibiotic choice for odontogenic infections due to their ineffectiveness against oral anaerobes. The second choice is first-generation cephalosporins. Amoxicillin, a broad-spectrum antibiotic, is considered for the treatment of immunocompromised patients.

2. **Sinus infections**

   Sinus problems often mimic the pain of odontogenic origin, and sometimes sinus infections may actually originate from dental issues. Oral and maxillofacial surgeons commonly encounter these conditions. Antibiotic treatment should be considered for patients who have been treated for 7 days with only decongestants and analgesics and who present with maxillary/facial pain or purulent nasal discharge.

   Patients experiencing severe pain or fever may require antibiotic therapy sooner, and hospitalization may be necessary. If antibiotics have been prescribed in the previous month or if the incidence of Streptococcus pneumoniae is over 30%, a combination of amoxicillin and clavulanic acid or a second-generation cephalosporin is prescribed for 2 weeks. Recent studies suggest that penicillin or amoxicillin alone is as effective as other broad-spectrum and expensive antibiotics.

   In chronic sinusitis, the flora becomes more anaerobic, and antibiotics alone may not be sufficient. Corrective surgery and consultation with an otorhinolaryngologist are indicated. For patients with diabetes mellitus, immunocompromised patients, or patients previously diagnosed with sinus infections who are on deferoxamine therapy, fungal infections should be suspected. Treatment with amphotericin B and surgery may be necessary[7].

3. **Osteomyelitis of the Jaws**

   Odontogenic pathogens are the most frequent causative agents of osteomyelitis. Actinomyces are another prominent pathogen in chronic osteomyelitis. Long course of antibiotic effective against these organisms are required. Oral penicillin plus probenecid can be used for long term outpatient therapy. Probenecid inhibits the renal excretion of penicillin and increases the blood level obtained by oral route.

4. **Fungal infections**

   Fungal infections encompass a broad range of infectious manifestations in the head and neck. Histoplasmosis and blastomycosis are major concerns for oral and maxillofacial surgeons, as they cause granulomatous lesions. Aspergillosis and mucormycosis typically result in sinusitis, while candidiasis causes surface lesions in non-immunocompromised patients and can progress to disseminated and invasive disease in immunocompromised individuals. Diagnosis involves sampling, culturing, histological examination, and the use of molecular methods.

   Treatment for fungal infections typically involves azole-type antifungal agents for less severe cases and amphotericin B for disseminated and severe disease. In cases of surface candidiasis in individuals with a healthy immune system, clotrimazole presents a better-tasting yet economical alternative to nystatin[7].

Recent Advances in Antibiotics used in Oral and Maxillofacial Surgery

Antibiotic-resistant bacterial strains have become increasingly prevalent and concerning over the past decade. Consequently, careful antibiotic selection is crucial to mitigate the promotion of drug-resistant organisms.

Linezolid, the inaugural antibiotic in the oxazolidinone class, recently received FDA approval. It is available in oral, oral suspension, and intravenous formulations, and demonstrates efficacy against gram-positive bacteria. This new antimicrobial disrupts bacterial protein synthesis earlier in the

cycle compared to other antibiotics.

Quinupristin/dalfopristin, the first drug in the streptogramin class, was FDA-approved in September 1999. It is indicated for treating bacteremia caused by vancomycin-resistant Enterococcus faecium (VREF). Efficacy rates include 63.4% for cellulitis, 36.8% for postoperative infections, and 60% for traumatic wound infections7.

Discussion

Antibiotics play a significant role in oral surgery, but their use must be carefully considered to ensure effectiveness and minimize risks.Antibiotics may be given before surgery to prevent infection, especially in patients with specific risk factors, such as those with heart conditions (e.g., endocarditis prophylaxis), immunocompromised individuals, or those undergoing extensive procedures.The use of antibiotics in oral surgery should be tailored to the individual patient and the specific procedure, taking into account factors like infection risks, potential resistance, and patient health. Proper use and monitoring are essential to achieve the best outcomes and minimizing risks.

To prevent infection in high-risk patients or procedures, such as those involving implants or patients with certain medical conditions. Avoid overuse to prevent antibiotic resistance. Tailor the choice based on local resistance patterns and patient-specific factors .Consider allergies, medical conditions, and potential interactions with other medications. Monitor for effectiveness and side effects, and adjust treatment as needed.

Antibiotics in oral and maxillofacial surgery should be used judiciously, guided by the specific needs of the patient and the procedure to optimize outcomes and minimize risks.

Conclusion

Antibiotics play a crucial role in oral and maxillofacial surgery, primarily for preventing and managing infections. Their use must be carefully tailored to each patient and procedure, considering factors such as the risk of infection, patient health, and local resistance patterns.

By adhering to these principles, oral and maxillofacial surgeons can effectively manage infection risks, enhance patient outcomes, and contribute to the broader goal of combating antibiotic resistance.

References

1. Aminov RI, Otto M, Sommer A. A brief history of the antibiotic era : lessons learned and challenges for the future. 2010;1(December):1–7.
2. Textbook of Pharmacology –KD Tripati , 8th edition
3. Fleming A. On the antibacterial action of cultures of a penicillium , with special reference to their use in the isolation of b . Influenz? 1E . 1929;(1923).
4. Laskin DM. The use of prophylactic antibiotics for the prevention of postoperative infections. 2003;15:155–60.
5. Ghafouri H, Bagheri-behzad B, Yasinzadeh M, Modirian E, Divsalar D. Prophylactic Antibiotic Therapy in Contaminated Traumatic Wounds: Two Days versus Five Days Treatment. 2012;2(1):33–7.
6. Associa- TAH. Antibiotic Prophylaxis In Dentistry: A Review And Practice Recommendations. 2001;131(March 2000).
7. Connor RCO, Shakib K, Brennan PA. Recent advances in the management of oral and maxillofacial trauma. Br J Oral Maxillofac Surg [Internet]. British Association of Oral and Maxillofacial Surgeons; 2015;1–9. Available from: http://dx.doi.org/10.1016/j.bjoms.2015.08.261

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Assessment of Morphological Variations Of The Inferior Alveolar Nerve Canal (IANC) Using Cone Beam Computed Tomography (CBCT) Amongst The North Indian Population: A Cross-sectional Study

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Abstract

Background: Morphological variations of the inferior alveolar nerve canal (IANC) have been described in literature, so the clinician must be able to recognise them and adapt their treatment accordingly.

AIM: To assess morphological variations of the course of inferior alveolar nerve canal (IANC) using cone beam computed tomography (CBCT) amongst the North Indian population.

Materials and methods:The study comprises of100 CBCT scans which were performed for various dental procedures, from the CBCT archives with the field of view (FOV) 10*5 cms or 10*10 cmsto assess the morphological variations of the Inferior Alveolar nerve canal (IANC).The scans were analysed by two examiners who had previously been trained as a specialist in oral and maxillofacial radiology.

Results:100 cbct scans were included where 53 were of female and 47 were of male; mean age of the individual was 47 ± 15.979 years. The prevalence of single mandibular canal was 93% (n = 93). According to Worthington classification the prevalence of single catenary type A was 54.83 % (n = 51), single progressive descending type B was 27.95% (n = 26) single straight type C was 17.85% (n = 16). There was no significant difference with the age (p = 0.750) and gender (p =0.760) respectively.The total prevalence of bifid MC was 7% (n =7), according to Langlais et al.13 classification the prevalence of bifid type 1 was 85.71% (n=6) (Graph 4) type 2 was 0% (n = 0); type 3 was 0 (n = 0) (Graph 4) and type 4 was 14.29% (n = 1). However, for each type of bifid MC, there was no statistically significant differences was found with the age (p= 0.136) and gender (p=0.069) respectively.The prevalence of anterior extension was 75% (n=16).AccordingGreenstein and Tarnow classification the prevalence of anterior extension type A was 0 (n=0), anterior extension type B was 25.0 % (n=12) and type C was 4 % (n=4). There were no statistically significant differences was found between the age (p = 0.371) and the gender (p =0.750.) respectively

Conclusion: CBCT is suggested for a detailed evaluation and identification of inferior alveolar nerve canals before any surgical procedures to avoid post-operative complications.

Introduction

The Inferior Alveolar nerve canal (IANC) or the Mandibular canal (MC) is an imperative anatomical structure that extends bilaterally from the Mandibular foramen to the Mental foramen carrying the Inferior Alveolar nerve, artery and vein. The Inferior Alveolar nerve is a branch of the third division of the fifth cranial nerve. It runs longitudinally through the spongy tissue of the bone in an anteroin ferior direction and describes as a concave antero-superior curve.[1] The IANC has been studied in detail since ages with respect to its location and path as well as the possible variations in its normal anatomical course.[2] (Figure.1) This important neurovascular bundle is responsible for the blood supply and sensory activity of the Mandibular teeth, lower lip, adjacent Alveolar bone and Gingiva. Radiographically, the MC is observed as a dark linear shadow between two thin, radio-opaque lines (one superior and the other inferior) projected on the bone, which

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limits the canal. (Figure.2)

Figure 1: The inferior alveolar nerve (IAN) canal[3]

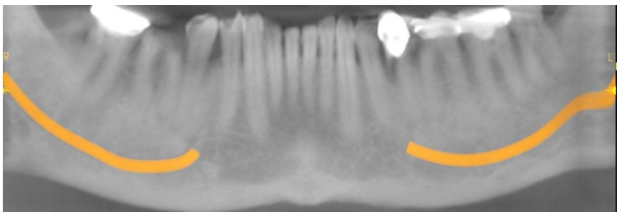


Figure 2: Radiographical representation of Inferior alveolar nerve canal

Anthropological study done by Chavez et al. suggested that during embryonic development there are three different Inferior Alveolar nerves which innervate three different areas of the hemi-mandible (anteroinferior teeth, primary molars and permanent molars), which finally fuse to form a single nerve. On this basis, some authors suggested that incomplete fusion of these three nerve branches results in the appearance of a bifid or trifid MC.[4]

Many authors have come up with categorization of the canal as per its topography or usual course and also tried to include the variations (if any) in its path both clinically as well as radiographically.

Acquaintance with the topography of the Inferior alveolar nerve canal is essential for various surgical procedures including dental implant placement, third molar surgery, dental anaesthesia, mandibular osteotomy, bone harvesting procedure from the ramus and body of mandible, bone plating in angle and body region of mandible, or any other surgical procedure involving the mandible to avoid inadvertent injury to inferior alveolar nerve (IAN). It has been reported that IAN damage may cause sensory deficitsup to 8.3% to 77.8%, depending on the type of surgery.[5]

Until the advent of CBCT, the panoramic radiographs were used to identify the morphological variations in the mandibular canals. Several studies done using orthopantomogram have shown lower prevalence of IANC variations when compare with CBCT, attributed to the lack of information provided in two-dimensional view.

Radiographic Assessment of The Infeior Alveoalr Nerve Canal

The radiographic appearance of mandibular canal has been described as a "radiolucent dark ribbon between two white lines" by Worth.[6] White & Pharaoh defined it as "dark linear shadow with thin radiopaque superior and inferior borders cast by the lamella of bone that bounds the canal". It occasionally duplicates in mediolateral directions as bifurcation and even as trifurcation.[7]

Genetic variations amongst different populations could be the cause behind the morphologic variation in the anato-mical landmark. Morphological variations are responsible for various complications during dental procedures which can handled by the clinicians if they have sound knowledge about various landmark and their variations.

The purpose of this study was to assess the morphological variations of the inferior alveolar nerve canal using CBCT in north Indian population.

Materials & Method

The present study was conducted in the Department of Oral Medicine and Radiology, ITS Dental College, Greater Noida, to assess the prevalence of morphological variations of the inferior alveolar nerve canal (IANC) in North Indian population. 100 CBCT scans were randomly selected from the archives which were performed from June 2022 to December 2023 according to the inclusion and exclusion criteria. Scans of patient from North India with radiographically evident corticated Inferior Alveolar nerve canalwith age above 18 and with known gender were included. Scans with evidence of fractures, pathological lesions, orthognathic surgery involving the mandible were not included in the study.

Image Evalution Using Cbct

All CBCT scans were reformatted using CS3D viewer software on LED 19"5' inch monitor screen with 1600 × 900 pixels resolution under dim light condition with standard protocol-Voltage: 60-90 kilovoltage peak, tube current: 2-15 mV, time: 12-28 sec, resolution: 180 µm- 200 µm and Gray Scale: 16 bits. Using the nerve marking tool, the course of the Inferior Alveolar nerve was traced using orange colour. The tracing was done in the panoramic view which can be viewed in the axial, coronal, and cross-sectional views. Evaluation and analysis of themorphological variations was performed by two examiners trained in the field of oral & maxillofacial radiology at specific interval of time.

Statistical Analysis

On a Microsoft Excel spreadsheet, the data were presented in a tabular form which had age, gender, presence of a single mandibular canal, bifid mandibular canal (right or left), and type of single and bifid mandibular canal were documented along with anterior extension types. The data were analyzed using SPSS software (SPSS version 27.0, SPSS, Chicago, IL, USA). Categorical data were analyzed for differences between groups based on gender, side, and canal type using the Chi-square test. Intra- and interobserver reliability was determined using Cohen's kappa coefficient. McNemar's test compared the prevalence of mandibular anatomical variations in 100 CBCT scans. The kappa coefficient to calculate the agreement between the observer 1 and observer 2 was 99% with the significance level set at $P \leq .0.05$.

Results

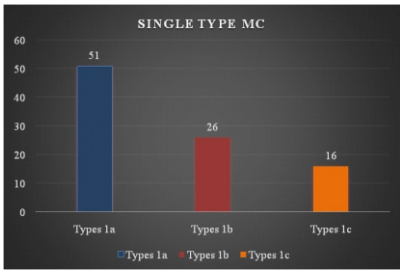
A total 100 CBCT scans were randomly selected from the archives, out of which 53 were those of females and 47 were of males. The age range of the individuals were within the age range of 18-86 years. Maximum age of the individual was 86 years while the minimum age was 18 years with an average of 47.42 years. The maximum number of the scans were of the individuals in the age group of 56-68 years (n=24). While the minimum number of scans were from the age group of 60-80 years (14)

Out of 100 CBCT scans, 62% were of right side of the mandible and 38% were of left side of the mandible. The total prevalence of single mandibular canal was 93% (n = 93) while that of the bifid mandibular canal was 7% (n=7) (Table-2).

TYPE	FREQUENCY	PERCENTAGE
SINGLE	93	93
BIFID	7	7
TOTAL	100	100

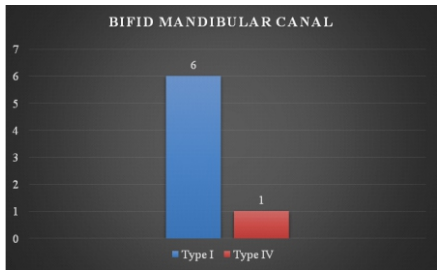
Table 2: Prevalence of the different types of MC.

According to Worthington [8] classification the prevalence of single Catenary type 1a was 54.83 % (n = 51), single Progressive descending type 1b was 27.95% (n = 26) single Straight type 1c was 17.85% (n = 16). (Table 3) There was no significant difference appreciated with the age (p = 0.750) and gender (p =0.760). (Graph 1)



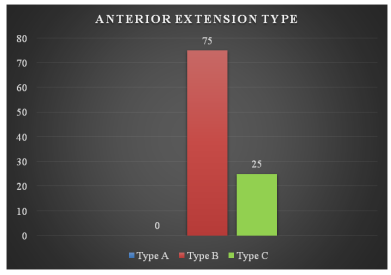
Graph 1: Prevalence of different types of single MC

The total prevalence of bifid MC was 7% (n =7), according to Langlais et al.[9] classification the prevalence of type 1 bifid MC was 85.71% (n=6) (Graph 4) type 2 was 0% (n = 0); type 3 was 0 (n = 0) (Graph 4) and type 4 was 14.28% (n = 1). However, for each type of bifid MC, there was no statistically significant differences was found with the age (p= 0.136) and gender (p=0.069). (Graph 2)



Graph 2: Prevalence of different types of bifid MC.

The prevalence of anterior extension of IANC was 16% (n=16). According to Greenstein and Tarnow [10] classificat-ion the prevalence of anterior extension type A was 0 (n=0), type B was 25.0 % (n=12) and type C was 4 % (n=4). (Graph 3) There were no statistically significant differences found between the age (p = 0.371) and gender (p =0.750.) respectively.



Graph 3: Prevalence of different types of anterior extension of MC.

Discussion

In the past, the studies aimed to assess the inferior alveolar nerve canal and its variants, were limited to gross evaluation on cadavers, dry skulls and the radiographic assessment using 2D imaging modalities like orthopantomogram.[3,11,12] Studies using CBCT for the evaluation of the MC represent a relatively pertinent area of research. Increased interest in this subject has been driven by greater frequency of placement of endo-osseous dental implants, advanced orthognathic surgeries, and the need to avoid morbidity associated with IAN injury during surgical procedures.

In the present study, the prevalence of single mandibular canal was found to be 93% (n=93) while bifid mandibular canal had a prevalence of only 7% (n=7). Nithya et al. conducted a similar study on 203 CBCT images out of which 21 images showed the presence of bifid mandibular canals indicating the prevalence of the of bifid canal as 10.3%.[13] Fuentes R et al. in his study on Chilean population, using digital panoramic radiography, reported the overall prevalence of bifid MC to be 11% (n = 102).[1] Anthropological study done by Chavez et al. suggested that during embryologic develo-pment three different mandibular canals occurred in each hemi mandible. Thereafter, from each canal three different inferior dental nerves originate and innervates the three mandibular regions. During prenatal growth phase of bone

remodeling and apposition, these three canals eventually fuse to form a single canal. Incomplete fusion of these three canals may result in anatomical variations such as bifurcation or trifurcation.[4]

Worthington´s classification for the categorization of the configuration of single IANC has been considered in the present study, according to which IANC can have three basic configurations i.e. Type 1 (Catenary), 2 (Progressive descending) and 3 (Straight). Catenary type was most commonly observed with a prevalence of 54.83% (n =51), followed by single Progressive Descending type with a prevalence of 27.95 % (n = 26) and then Straight type with a prevalence of 17.20% (n = 16).Unlike our study, a study conducted by Mirbeigi et al.,evaluated the course of IANC amongst the Iranian population using CBCT and reported an equal distribution (n=52) of three different categories of IANC.[14] Andrew Okiriamu et al. evaluatedthe course of IANC amongst the Kenyan popul-ation using CBCT and found Progressive descending type in 241 (68.7%) scans, Catenary type in 77 (21.9%) scans, and the Straight type in 33 (9.4%) scans.[12] Ozturk's et al. eval-uated the pattern of IANC on dry skulls of USA population using CBCT and observed Catenary type in almost one-half (51.1%) of the specimens, followed by the Progressive descending (36.7%) and then Straight type (12.2%).[15] Therefore, as observed demographic variations can be attributed as the reason behind Catenary being the most prevalent type.

After observing the prevalence rate of the bifid canal, the present study applied Langlais et al. classification for categorization of the course of bifid IANC. According to which the bifid canals can be categorised into 4 types with further subtypes.[9] Our study observed the prevalence of further subtypes such as Type I as 85.71% (n = 6), type II as 0% (n = 0), type III as 14.28% (n = 1) and type IV as 0% (n = 0). Following the same classification Komal et al. conducted a study of normal anatomy of mandibular canal and its variations in Indian population using CBCT. They observed only 1% prevalence of bifid mandibular canal which was Type 2 in nature.[16]

In its first kind of a study to know the prevalence of bifid mandibular canal, conducted by R P .Langlais, R Broadus, B J Glasson 6000 panoramic radiographs ,the authors reported the prevalence of bifid MC as 0.95%, with type II being the most frequent variant. The prevalence rate of type II was reported as 54.4% followed by type I with the prevalence of 38.6%. Type III & Type IV had equal prevalence of 3.5 %.[10]

Fuentes R, et al. applied the same classification system on Chilean population using digital panoramic radiography and reported the prevalence of Type I bifid MC as 7.4% (n = 69), type II as 2.3% (n = 23), type III as 0% (n = 0) and type IV as 1.1% (n = 10).[1] Another study byKalantar Motamedi et al. conducted on 5000 panoramic radiographs reported the most frequently encountered type of bifid canal as type 2 (82%).[17]

Hass L F et al. suggested that CBCT showed a higher prevalence of variations in mandibular canal (16.25%) when compared to panoramic radiography (6.46%).[18]

The previous studies reported that the prevalence of bifid mandibular canal identified using CBCT was higher than that obtained using panoramic radiographs. Tantanapornkul et al. compared panoramic radiographs and CBCT in the detection of mandibular canal and reported that CBCT had 93% of sensitivity and 77% of specificity.[19] They concluded that CBCT can be used for more accurate visualization of mandibular nerve. Neves et al. assessed the presence of bifid mandibular canal using panoramic radiograph and CBCT. They reported 2.4% higher prevalence of bifid mandibular canal when observed through CBCT.[20] Therefore, the present study used CBCT for visualization of inferior alveolar nerve canal.

In the present study overall prevalence of anterior extension amongst the single and bifid MC was found to be 16% (n=16). Gupta A et al. reported a prevalence rate of 56.0 % of anterior loop in a total sample of 600 CBCT scans while Puri et al. found the prevalence rate of 53.13%, in a total sample of 5 CBCT scans done in a pilot study, on the West Indian population. [21,22] On the contrary a study carried out by Sinha et al. in East Indian population found that the preval-ence rate of anterior loop was only 9.7%on CBCT images.[23] Further more Kajan and Salari reported the prevalence of 36.9% anterior loop amongst the Iranian population in his study conducted in 2012 using CBCT.[24] Also, De Oliveira- Santos et al. reported an overall prevalence rate of 22%– 28% of the anterior loop in 100 CBCT scans.[25] On a study conducted on panoramic radiographs, Ngeow et al. reported 40.2% of anterior loop on panoramic radiographs.[26]

Nina and Stoltzesuggested that the visibility of anterior loop reduces as the age of the subjects increased. The difficulty in visualizing the anterior loop in older subjects may be a result of reduced calcification of the cortex which happens with age progression.[27]

Greenstein and Tarnowin their review gave a pictorial representation of different types of anterior extension of inferior alveolar nerve canal.[10] In this present study we applied the same pictorial representation for knowing the prevalence of anterior extension types. The prevalence of anterior extension type A was 0.0% (n=0), type B was 12.0 % (n=12) and type C was 4%(n=4). It was found that type B was the most common followed by type C and then type A.

The limitation of the present study is that of a small sample size. The variation in the pattern of morphological types of IANC could be attributed to the differences in the study sample size, methodology, and the varied population groups. Studies on larger sample size in diverse population needs to be done to draw a definite conclusion.

Conclusion

CBCT provides an effective tool for presurgical evaluation of the neurovascular structures and its variations. This knowledge is pertinent in the preoperative assessment and planning of surgeries. This information shall be helpful inavoidance of iatrogenic injuries which tend to occur during the surgical procedures in the maxillofacial region.

We conclude that CBCT is suggested for a detailed evaluation to avoid post-operative complications and contribute to the provision of safe and effective dental care, ultimately enhancing the patient's experience.

References

1. Fuentes R, Arias A, Farfán C, Astete N, Garay I, Navarro P, Dias FJ. Morphological variations of the mandibular canal in digital panoramic radiographs: a retrospective study in a Chilean population. Folia Morphol (Warsz). 2019 ; 78(1):163-170.
2. Bruneder S, Schwaiger M, Kerner A, Steyer G, Toferer A, Zemann W, Hammer N, Brcic L, Avian A, Wallner J. Expect the unexpected: The course of the inferior alveolar artery - Preliminary results and clinical implications. Ann Anat. 2022; 240:151867.
3. Hur MS, Kim HC, Won SY, Hu KS, Song WC, Koh KS, Kim HJ. Topography and spatial fascicular arrangement of the human inferior alveolar nerve. Clin Implant Dent Relat Res. 2013 ;15(1):88-95.
4. Chávez-Lomeli ME, Mansilla Lory J, Pompa JA, Kjaer I. The human mandibular canal arises from three separate canals innervating different tooth groups. J Dent Res. 1996 ;75(8):1540-1544.
5. Mizbah K, Gerlach N, Maal TJ, Bergé SJ, Meijer GJ. The clinical relevance of bifid and trifid mandibular canals. Oral Maxillofac Surg. 2012; 16(1):147-151.
6. Worth HM. Normal radiographic appearances of the teeth and jaws and variations within the normal. In: Principles and practice of oral radiologic interpretation. Chicago, IL: Year Book Medical Publishers, Inc; 1963. 15–79.
7. Stuart C. White, Pharoah, editor. Oral radiology, principles and interpretation. 5th edition St. Louis, Missouri: Elsevier. 2006; 184.
8. Worthington P. Injury to the inferior alveolar nerve during implant placement: a formula for protection of the patient and clinician. Int J Oral Maxillofac Implants. 2004 ;19(5): 731-734.
9. Langlais RP, Broadus R, Glass BJ. Bifid mandibular canals in panoramic radiographs. J Am Dent Assoc. 1985; 110 (6): 923-926.
10. Greenstein G and Tarnow D. The foramen and mental nerve: clinical and Anatomical factors related to dental implant placement: a literature review, Journal of Periodontology, 2016; 77(12): 1933–1943.
11. Kim MS, Yoon SJ, Park HW, Kang JH, Yang SY, Moon YH, Jung NR, Yoo HI, Oh WM, Kim SH. A false presence of bifid mandibular canals in panoramic radiographs. Dentomaxillofac Radiol. 2011;40(7):434-438.
12. Okiriamu A, Fawzia B, Florence O, Fredrick O. Morphology and Variant Anatomy of the Mandibular Canal in a Kenyan Population: A Cone-Beam Computed Tomography study. Craniomaxillofacial Research & Innovation. 2023;8.
13. Nithya J, Aswath N. Assessing the Prevalence and Morphological Characteristics of Bifid Mandibular Canal Using Cone-Beam Computed Tomography - A Retrospective Cross-Sectional Study. J Clin Imaging Sci. 2020; 10:30.
14. Mirbeigi S, Kazemipoor M, Khojastepour L. Evaluation of the Course of the Inferior Alveolar Canal: The First CBCT Study in an Iranian Population. Pol J Radiol. 2016; 81: 338-341.
15. Ozturk A, Potluri A, Vieira AR. Position and course of the mandibular canal in skulls. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Apr;113(4):453-458.
16. Komal A, Bedi RS, Wadhwani P, Aurora JK, Chauhan H. Study of Normal Anatomy of Mandibular Canal and its Variations in Indian Population Using CBCT. J Maxillofac Oral Surg. 2020 ;19(1):98-105.
17. Kalantar Motamedi MH, Navi F, Sarabi N. Bifid mandibular canals: prevalence and implications. J Oral Maxillofac Surg. 2015 ;73(3):387-390.
18. Haas LF, Dutra K, Porporatti AL, Mezzomo LA, De Luca Canto G, Flores-Mir C, Corrêa M. Anatomical variations of mandibular canal detected by panoramic radiography and CT: a systematic review and meta-analysis. Dentomaxillofac Radiol. 2016;45(2):20150310.
19. Tantanapornkul W, Okouchi K, Fujiwara Y, Yamashiro M, Maruoka Y, Ohbayashi N, Kurabayashi T. A comparative study of cone-beam computed tomography and conventional panoramic radiography in assessing the topographic relationship between the mandibular canal and impacted third molars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007 Feb;103(2):253-259.
20. Neves FS, Nascimento MC, Oliveira ML, Almeida SM, Bóscolo FN. Comparative analysis of mandibular anatomical variations between panoramic radiography and cone beam computed tomography. Oral Maxillofac Surg. 2014 ;18(4):419-424.
21. Gupta A, Kumar S, Singh SK, Kumar A, Gupta A, Mehta P. Assessment of Anterior Loop of Inferior Alveolar Nerve and Its Anatomic Variations with Age, Gender, and Dentition Status in Indian Population: A CBCT Study. Int J Dent. 2021; 31:1813603.
22. A Puri, P. Verma, P. Mahajan, A. Bansal, S. Kohli, and S. A. Faraz, "CBCT evaluation of the vital mandibular interforaminal anatomical structures," Annals of maxillofacial surgery.2020; 10(1): 149-157.
23. S. Sinha, S. Kandula, N. C. Sangamesh, P. Rout, S. Mishra,

and A. A. Bajoria, "Assessment of the anterior loop of the mandibular canal using cone-beam

24. Kajan ZD, Salari A. Presence and course of the mandibular incisive canal and presence of the anterior loop in cone beam computed tomography images of an Iranian population. Oral Radiology. 2012; 28:55-61.
25. De Santos Oliveira R, Maria Gomes Oliveira A, Cintra Jun-queira JL, Kühl Panzarella F. Association between the Ana-tomy of the Mandibular Canal and Facial Types: A Cone-Beam Computed Tomography Analysis. Int J Dent. 2018; 10:5481383.
26. Ngeow WC, Dionysius DD, Ishak H, Nambiar P. A radiographic study on the visualization of the anterior loop in dentate subjects of different age groups.J Oral Sci. 2009; 51:231-237.
27. Von Wowern N, Stoltze K. Pattern of age-related bone loss in mandibles.Scand J Dent Res.1980; 88:134-146.

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Exploration of Dental Lasers in Managing Oral Mucositis and Burning Mouth Syndrome

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Abstract

This article explores the pivotal role of dental lasers in managing oral mucositis and burning mouth syndrome. With a focus on their mechanisms of action, this comprehensive review delves into the etiology, clinical features, and conventional treatment methods for both conditions. Additionally, it sheds light on the emerging field of photobiomodulation, outlining its advantages in addressing these oral afflictions. The article aims to provide an understanding of how dental lasers are reshaping the landscape of oral healthcare.

Keywords: Low-Level Laser Therapy, Photobiomodulation, Oral Mucositis, Burning Mouth Syndrome

Introduction

Dental lasers have revolutionized oral healthcare, offering precise and minimally invasive solutions for various conditions. Photobiomodulation (PBM), also known as low-level laser therapy (LLLT), has emerged as a promising and innovative approach in the field of dentistry. involves the use of low-intensity lasers or light-emitting diodes to stimulate cellular processes without causing thermal damage. In the context of oral health, LLLT has gained attention for its potential in managing various conditions, including oral mucositis and burning mouth syndrome. This non-invasive and light-based therapy holds significant potential in various dental applications, ranging from pain management to tissue repair. This article explores the transformative role of photobiomodulation in dentistry, highlightingtheir application in addressing oral mucositis and burning mouth syndrome.

What is Oral Mucositis?

Oral mucositis is a debilitating condition often associated with cancer treatments, particularly chemotherapy and radiation therapy. The inflammatory response and ulceration of the oral mucosa can lead to severe pain, difficulty in swallowing, and compromised oral hygiene. The primary cause of oral mucositis is the cytotoxic effects of cancer treatments on rapidly dividing oral mucosal cells. Chemotherapeutic agents and radiation disrupt the integrity of the oral mucosa, triggering an inflammatory response. Patients with oral mucositis often experience pain, swelling, and difficulty in swallowing. Severe cases may lead to the development of ulcers, compromising oral hygiene and nutritional intake. Traditional approaches to managing oral mucositis include palliative care, pain management, and topical agents. However, these methods often provide limited relief and do not address the root cause.

PBM operates on the principle of delivering low-level laser or light energy to the affected tissues. In the context of oral mucositis, this therapy has demonstrated effectiveness in promoting tissue repair and reducing inflammation. The non-thermal, low-intensity light activates cellular processes, accelerating the healing of damaged oral mucosal cells. PBM's ability to modulate inflammatory responses provides a targeted and adjunctive approach to conventional treatments, offering patients a potential pathway to enhanced comfort during cancer therapies.

Burning Mouth Syndrome

Burning Mouth Syndrome (BMS) is another chronic challenging condition

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characterized by a persistent burning sensation in the mouth, often accompanied by taste alterations and dryness. The exact cause of burning mouth syndrome remains elusive, with factors such as hormonal changes, oral infections, and psych-ological elements being implicated. The condition predomin-antly affects postmenopausal women. Patients with burning mouth syndrome report a constant burning or tingling sensa-tion in the oral cavity, impacting their quality of life. Taste disturbances and dry mouth further contribute to the comple-xity of this condition.

Traditional treatment approaches involve symptom mana-gement through the use of medications, lifestyle modifications, and psychological support. However, these methods do not consistently provide relief.

Photobiomodulation operates on the principle of utilizing low-level laser to stimulate cellular processes without causing thermal damage. The specific wavelengths employed during this therapy interact with cellular components, leading to a cascade of biological responses. These responses include increased ATP production, improved cellular metabolism, and modulation of inflammatory processes. In the context of dent-istry, these mechanisms contribute to enhanced tissue repair, reduced inflammation, and pain management.

Dental lasers, particularly diodes and CO2 lasers, have shown promise in alleviating symptoms associated with burning mouth syndrome. The precision of laser therapy allows for targeted treatment, reducing pain and discomfort.

These lasers primarily work by promoting tissue regenera-tion and reducing nerve sensitivity. The controlled thermal energy delivered by the laser modulates neural responses, providing relief from the burning sensation.

Advantages of Photobiomodulation in Dentistry:

Photobiomodulationoffers several advantages, including non-invasiveness, minimal side effects, and the ability to enhance tissue repair. The modulatory effects on inflammation and pain make it a promising adjunct to conventional treatm-ents for oral mucositis and burning mouth syndrome.

Non-Invasiveness: Photobiomodulation is non-invasive, making it a patient-friendly option that avoids the complica-tions associated with more invasive procedures.

Minimal Side Effects: LLLT is associated with minimal side effects, contributing to its safety profile. Patients experience little to no discomfort during the therapy.

Precision: The targeted nature of photobiomodulation allows for specific treatment of affected areas, ensuring focu-sed therapeutic effects without affecting surrounding healthy tissues.

Conclusion:

Dental lasers, coupled with the emerging field of low-level laser therapy, present a paradigm shift in the management of oral mucositis and burning mouth syndrome. The precision, targeted action, and minimal invasiveness of laser therapy offer new avenues for improving the quality of life for patients suffering from these conditions. As technology continues to advance, dental lasers are poised to play an increasingly integral role in shaping the future of oral healthcare.

References:

1. Lodi G, Sardella A, Bez C, et al. Interventions for treating oral leukoplakia. J Evid Based Dent Pract 2008; 8(1):8-9.
2. Srivastava VK, Mahajan S. Diode lasers: a magical wand to an orthodontic practice. Indian J Dent Res. 2014 Jan-Feb;25(1):78-82. doi: 10.4103/0970-9290.131138. PMID: 24748305.
3. Strauss RA. Lasers in oral and maxillofacial surgery. Dental clinics of North America 2000; 44(4):851-73.
4. Mahajan S, Srivastava V, Coluzzi D. J. Where to begin? Lasers in Dentistry -Current Concepts. 2017; 3-15.
5. Srivastava V, Mahajan S. Practice management with dental lasers. J Laser Dent. 2011;19(2):209–11.16.
6. Srivastava VK, Mahajan S. Diode lasers: a magical wand to an orthodontic practice. Indian J Dent Res. 2014; 25(1): 78–82.
7. Goharkhay K, Moritz A, Wilder-Smith P, et al. Effects on oral soft tissue produced by a diode laser in vitro. Lasers in surgery and medicine 1999; 25(5):401-6.

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Importance of Non Surgical Therapy In Periodontology Prior to Surgical Therapy : A Review

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Abstract

Plaque and calculus are the sole etiological factor for the causation of gingivitis which if not controlled through proper treatment plan can lead to the periodontitis.Thenon surgical therapyforms the base for the further stages of treatment plan in both the gingivitis and periodontitis as this non surgical therapy gives a true idea about whether the patient is indicated for the surgical therapy or not,to what extent the patient is concern about his or her oral health. Taking these considerations,this short communication highlights the importance of non-surgical therapy in controlling the gingival inflammation and then the true decision about the surgical considerations.

Keywords : Plaque, calculus, inflammation, scaling, root planning, attitude, diagnosis

Introduction

In the field of Periodontology, taking into consideration, about the diseased part, so because of inflammation, two diseases are of an utmost important concern; gingivitis and periodontitis. These inflammatory disease has two major important factors; plaque and the calculus. For controlling the inflammation and its progression, the most important thing that needs to be done is the complete elimination of the plaque and the calculus so that the gingival tissues and henceforth the periodontal tissues remain in their healthy state.[1]

Non Surgical Therapy In Periodontics

Since it's a proven fact, that the sole etiological factor for the causation of gingivitis and periodontitis is the plaque and the calculus, hence the control of these factors form the basis of non surgical therapy or phase 1 therapy in the field of Periodontology.

A. Measures In Non Surgical Therapy

Non surgical therapy consist of those important measures that are essential to maintain the gingival and the periodontal tissues in their state of equilibrium. It involves the following measures.

1. **Scaling and root planning:** Once the plaque get mineralized into calculus,then it becomes difficult by the patient itself to remove these deposits from his or her gingiva by routine oral hygiene measures. Hence a professional cleaning of the teeth is needed to remove these deposits from the gingiva. Henceforth scaling refers to the mechanical removal of plaque and calculus from the gingival surface both supragingivally and subgingivally.[2] When the tooth and the gingival surface get occupied by these microbial deposits then this microbial colony also makes the cementum of the root surface diseased.[6] Hence here comes the importance of root planning which refers to the gentle removal of this toxic and necrotic cementum; so that a healthy cemenentum occupies the root surface of the tooth. Hence this scaling and root planning forms the most important measure of all the other oral hygiene measures for making the gingiva in a diseased free state.[9]

It is also a proven fact that if a non surgical intervention i.e. scaling and root planning is carried out, then its maintainance is also an important concern as apart from the periodontist who plays the role in the correct way of scaling and root planning, the major role in the maintainance of this cleaning is by the patient.[3] Hence from the patient point of

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view, the following non surgical oral hygiene measures after scaling and root planning are important and they are as follows:[4]

1. **Proper brushing technique:** In order for the plaque to not get deposited on the tooth surface; proper brushing by the patient is important. This proper brushing technique includes:
   a. **Method of brushing:** In the field of Periodontics, three types of brushing techniques are important: Modified Bass Method, Modified stillman method, Charters method. Now among these methods of toothbrushing, which one needs to be advised to the patient is based upon the clinical condition of the patient and so is instructed by the Periodontist to the patient, that which brushing method is best suitable for the patient so that his or her oral health remains stable.[4]
   b. **Duration of brushing :** it refers to as for how much time the patient brushes his or her teeth as well how many times the patient do toothbrushing. Usually it is advisable that 2 minute brushing time is sufficient to remove deposits from the tooth surface and toothbrushing two times a day is much sufficient to maintain the oral health in a good state.[4]
2. **Use of Mouthwashes :** The mechanical method particularly after the professional cleaning is not alone sufficient and hence chemical method of plaque control is also important in removal of the plaque and calculus build up from the teeth as well to deal up with the halitosis which is also one of the symptoms of the poor oral health. The prescription of these mouthwashes by the periodontist to the patient depends upon what the patient chief complaint was as a common mouthwash never ever solves all the oral problems of the patients and these prescriptions of the mouthwashes vary from patient to patient as well within the same patient.[4]
3. **Use of interdental aids :** The biggest disadvantage of the toothbrushing and the mouthwash is that these cannot clean the interdental area in a much effective manner because of which the interdental area is the first site in which the plaque gets accumulated and leads to the initiation of gingivitis. Hence here the role of interdental aids comes into consideration. Interdental aids refer to a manual cleaning device that can remove remanants of food particles from an interdental area and hence helps to maintains the interdental hygiene and the overall oral hygiene in a good manner.[4]

   These interdental aids consist of dental floss and the interdental brushes (which are again of two types: narrow space interdental brush; and the wide space interdental brush. Again, which interdental aids is best suitable to the patient is decided by the periodontist based upon the initial clinical condition of the patient.[10]

B. Importance of non surgical therapy

Non surgical therapy is carried out for the removal of the plaque and the calculus and by the removal of this plaque and calculus;following important considerations can be seen:

1. **Resolution of inflammation :** Since this microbial colony leads to the inflammation of the gingiva, hence by the removal of this microbial colony, resolution of the inflammation occurs which gives the clear view about the surgical considerations for a particular clinical case. And if the surgery becomes indicated then it provides the firm base for the better incision and intraoperatively gives proper visibility and accessibility to the operating side.[7]
2. **Change of Diagnosis :** A properly performed non surgical therapy, gives a more confirmatory view about the provisional diagnosis i.e. whether the provisional diagnosis is same as the final diagnosis (made after non surgical therapy) or the final diagnosis becomes different for that particular clinical case.[7]
3. **Patient attitude towards oral health :** Non surgical therapy reveals the true attitude of the patients about how much the patient is concerned regarding their oral health and this judgement is done by the periodontist based upon following the proper oral hygiene measures provided to the patient after the professional cleaning. This judgement also shows that these patients are an absolute indication or contraindication to the surgical intervention if needed.[8]

Image based discussion of the clinical case:

In the first picture a highly inflamed and the swollen gingiva is seen of the left mandibular canine and based upon this clinical presentation, a provisional diagnosis of chronic localized periodontitis was made with respect to the left mandibular canine. Hence the non surgical therapy was started with the scaling, root planning and curettage and the reinforcement of all the oral hygiene measures as described above to the patient and the patient was recalled after 7 days.

In the second picture as the patient came for the follow up after 7 days, complete resolution of the inflammation was noted. Hence the final diagnosis was made as chronic localized gingivitis with respect to the left mandibular canine as compared to the provisional diagnosis which was chronic localized periodontitis as well the need for surgery was eliminated as compared to when the surgical intervention was advised to the patient based upon the provisional diagnosis.

Fig 1 : Highly inflamed swollen gingiva of left mandibular canine.

The Provisional diagnosis was chronic localized Periodontitis

Fig 2 : Complete resolution of the gingival inflammation of Mandibular left canine following the incorporation of non Surgical therapy with the change of final diagnosis to Chronic localized gingivitis.

Conclusion

Non surgical therapy is an important diagnostic factor that can determine the prognosis, treatment plan, and the attitude of the patients towards their oral health. Non surgical therapy should not be skipped at any cost because many of the times it gives a clear clue and the view about managing the proper treatment for the patient and if done in a correct way can result in reverting back the normal gingiva characterstic features from the diseased gingiva.

References

1. Bhansali RS. Non Surgical Periodontal therapy: An update on current evidence. World J Stomatol 2014; 3:38-51
2. Of fenbacher S. Periodontal diseases pathogenesis. Ann Periodontal 1996;1:821-878.
3. Tanwar J,Dodani K. Non surgical periodontal therapy: A review. J Oral Res 2016;8:39
4. Khan S,Khalid T. Non-surgical periodontal therapy effectively improves patient reported outcomes: a systematic review. Int J Dent Hyg. 2021;19:18-28.
5. Kloostra PW, Eber RM. Surgical versus non-surgical periodontal treatment: psychosocial factors and treatment outcomes. J Periodont. 2006;77:1253-1260.
6. Aleo JJ, Farber PA. The presence and biologic activity of cementum bound endotoxin. J Periodontal. 1974; 45(9): 672-675.
7. Philstrom BL. A randomized four year study of periodontal therapy. JPeriodontol.1981; 52(5):227-242
8. Morrison EC, Hill RW. Short term effects of initial, non surgical periodontal treatment (hygienic phase). J Clin Periodontol.1980;7(3):199-211.
9. Ramjford SP. Root planning and curettage. Int Dent J. 1980;30(2):93-100.
10. Sweeney PL, Smith BA. Scaling and root planning with and without Periodontal flap surgery. J Clin Periodontol. 1986;13(3):205-210.

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Smart Materials In Orthodontics : A Futuristic Approach

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Introduction

The importance of a well-coordinated interaction of orthodontists with biomedical engineers for the production of many customised orthodontic appliances has been underappreciated[1]. Usually, the bio-medical engineers, hired by many orthodontic appliance manufacturing companies, develop the appliances, overlooking the day-to-day clinical difficulties faced by the orthodontists in their busy practices[2]. Innovations are the need of the hour which could address a critical clinical concern; for example, a material that has easy handling characteristics and shortens chair side time or one that significantly improves the quality of treatment by addressing important variables such as treatment, duration and cost. The aim of this review is to describe the current trends and innovations of biomedical materials and their implications in orthodontic science[3,4].

Shape-memory polymers (SMPs): Polymers play a vital role in orthodontics and dentistry due to their diverse applications. Aesthetic concerns, particularly the metallic appearance of traditional orthodontic appliances like brackets and archwires, have driven the development of alternatives such as ceramic, plastic, or polycarbonate brackets and Teflon-coated archwires[5]. Shape Memory Polymers (SMPs) are advanced materials that can return to their original shape after deformation when triggered by external stimuli like heat, light, or water. Their unique properties include transparency, lightweight nature, cost-effectiveness, and a shape-recovery force lasting up to three months[6]. With a glass transition temperature close to body temperature, SMPs are especially useful for aligning and leveling teeth in patients seeking aesthetic solutions. These polymers are effective in correcting malaligned or severely rotated teeth and have become increasingly popular among clinicians[7,8].

Brackets with force moment sensors : When a two couple system or an indeterminate force system is employed using orthodontic appliances, the amount of forces and moments cannot be appropriately determined. Lapatki et al. developed a smart bracket equipped with a stress sensor system embedded in its base, designed to measure the three-dimensional forces and moments acting on the bracket and subsequently on the tooth. None of the material has been tested yet , research is still pending in this sector[8-10].

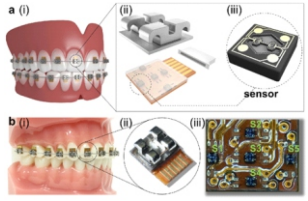

Fig 1 : Brackets with force moment sensors

Self-healing materials : In recent decades, hydrogels with remarkable bio-mimicking characteristics have been developed. Studies have highlighted cross-linked hydrogels capable of self-healing, showcasing their advanced functional properties. These materials can be incorporated in wires and brackets in form of nano sized bubbles . When a bracket breaks, these bubbles release the monomer, which polymerizes upon exposure to air, filling the fractured space. This process helps reduce bracket and wire damage and shortens overall treatment time[10-12].

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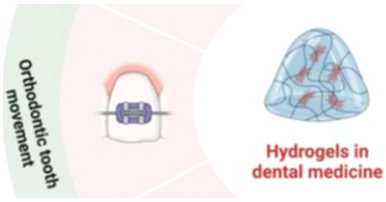

Fig 2 : Hydrogel In Medicines

Biomimetic adhesives : Attaching brac-kets to the tooth surface involves preconditi-oning the enamel, which results in changes to its thickness and color. Hence to prevent da-mage to tooth surface a biomimetic material naming Geckelwas introduced. This adhe-sive combines elements inspired by the natu-ral adhesion mechanisms of geckos and mussels, functioning effectively in both dry and wet environments. In orthodontics, biom-imetic adhesives are applied by coating bracket bases with L-3,4-dihydroxyphenylalanine (DOPA), a key adhesive protein found in mussels. DOPA ensures strong bonding to the enamel surface. Works well in both dry and wet conditions[13].

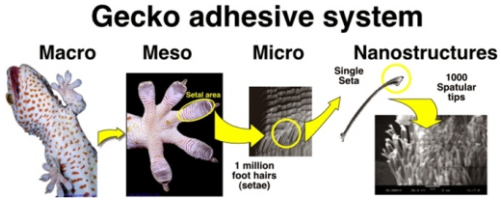

Fig 3: Showing gecko adhesive system

Self-cleaning materials : Plaque buildup around brackets and tooth surfaces can severely harm the periodontium, leading to issues like gingivitis, bone loss, and white spot lesions. The use of materials capable of effectively removing organic and inorganic deposits from calcified surfaces and brackets has been under research to mitigate these effects. The photo-catalytic properties of titanium oxide with UV light are a key focus in orthodontic materials. Nickel-titanium archwires are modified into crystalline rutile by electrolytic titanium oxide film treatment followed by heat application[14].

Biodegradable or bioresorbable miniimplants : These polymer materials address the risk of inflammation, infection, and loosening associated with conventional temporary ancho-rage devices. However, ensuring the safe removal of their byproducts from the body remains essential. By changing the ratio of PLA/PGA such product can be made .They have a setback of delayed resorption time. Continues studies and research will perhaps facilitate development od such a product[12].

Fluoride releasing materials : Bonding materials like compomers and resin-modified glass ionomer cements (RMGICs) have demonstrated a reduction in caries developm-ent but require further trials due to concerns about their bond strength. The transformation of hydroxyapatite into fluorapa-tite crystals enhances fluoride's anti-cariogenic properties, as high fluoride levels in plaque are bactericidal and help prevent enamel demineralization. Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) supports calcium and phosphate retention in plaque, preventing their loss and promoting remineralization[15].

To maintain elevated fluoride levels in orthodontic patie-nts, methods such as slow-release devices, chewing gums, and elastomers have been utilized, showing increased fluoride presence in the oral cavity. However, incorporating fluoride into these materials significantly alters their mechanical prop-erties. Extensive trials are needed to establish standardized guidelines for fluoride use in orthodontics to minimize adverse effects like white spot lesions and ensure safe, effective treatment[16].

BPA free polymers : Orthodontic materials must be biocompatible with oral tissues, non-toxic, and mechanically stable throughout treatment. A growing concern is the release of Bisphenol-A (BPA) from materials like polycarbonate brackets and orthodontic composites (e.g., bis-DMA), thermo formed Biocryl retainers and Transbond XT. BPA exposure is linked to health risks such as premature puberty, ovarian cancer, disruption of male reproductive organ development, and increased anxiety, depression, and social difficulties in children. Methods to reduce BPA leaching include soaking retainers in hot water for a few hours prior to delivery, removing any excess adhesive before curing, ensuring that all adhesive is fully cured around the bracket's peripheral mar-gins, having the patient rinse with warm water after bonding, and/or using an orthodontic adhesive that does not contain a BPA derivative which includes EXA , EXB,Phenyl carbamoyloxy -propane dimethacrylate (PCDMA) and Aromatic-free ureth-ane dimethacrylate monomers[17].

Conclusion : This review explored biomedical materials, their current trends, orthodontic applications, and future pers-pectives. Collaboration between orthodontists and biomedi-cal engineers is crucial for customizing orthodontic appliances, ensuring better patient outcomes with minimal complications from the tools used.

Referrences

1. Nikolai RJ. Bioengineering analysis of orthodontic mechanics. In: Lea &Febiger, Philadelphia; 1985:55.
2. Kusy RP, Greenberg AR. Effects of composition and cross section on the elastic properties of orthodontic wires. Angle Orthod 1981; 51:325-41.
3. Wong BH. Invisalign A to Z. Am J Orthod Dentofacial Orthop 2002; 121:540-1.
4. Fuck LM, Wiechmann D, Drescher D. Comparison of the initial orthodontic force systems produced by a new lingual bracket system and a straight-wire appliance. J OrofacOrthop 2005; 66:363-76.
5. Kocadereli I, Canay S, Akça K. Tensile bond strength of ceramic orthodontic brackets bonded to porcelain

surfaces. Am J Orthod Dentofacial Orthop 2001; 119:617-20.

6. Behl M, Lendlein A. Shape-memory polymers. Mater Today 2007; 10:20-8.
7. Jung YC, Cho JW. Application of shape memory polyurethane in orthodontics. J Mater Sci Mater Med 2010; 21:2881-6.
8. Eliades T. Orthodontic material applications over the past century: Evolution of research methods to address clinical queries. Am J Orthod Dentofacial Orthop 2015; 147:224-31.
9. Gündüz E, Zachrisson BU, Hönigl KD, Crismani AG, Bantleon HP. An improved transpalatal bar design. Part I. Comparison of moments and forces delivered by two bar designs for symmetrical molar derotation. Angle Orthod 2003; 73:239-43.
10. Badawi HM, Toogood RW, Carey JP, Heo G, Major PW. Threedimensional orthodontic force measurements. Am J Orthod Dentofacial Orthop 2009; 136:518-28.
11. Chen J, Dong Q, Ma X, Fan T, Lei Y. Repetitive biomimetic selfhealing of Ca2+ induced nanocomposite protein hydrogels. Sci Rep 2016; 6:30804
12. 7. Phadke A, Zhang C, Arman B, Hsu CC, Mashelkar RA, Lele AK, et al. Rapid self-healing hydrogels. Proc Natl Acad Sci 2012; 109:4383-8.
13. Chen J, Dong Q, Ma X, Fan T, Lei Y. Repetitive biomimetic selfhealing of Ca2+ induced nanocomposite protein hydrogels. Sci Rep 2016; 6:30804.
14. Xu Q, Zhang W, Dong C, Sreeprasad TS, Xia Z. Biomimetic self-cleaning surfaces: Synthesis, mechanism and application. J Royal Soc Interface 2016; 13:20160300
15. Chuan X, Chen L. Effects of enamel surface preparation on bonding strength of resin-modified glass ionomer cement: An in vitro study. J Adhes Sci Technol 2018; 31:2300-11
16. Burgess JO, Vaghela PM. Silver diamine fluoride: A successful anticarious solution with limits. Adv Dent Res 2018; 29:131-4.
17. Kotyk MW, Wiltshire WA. An investigation into bisphenol-A leaching from orthodontic materials. Angle Orthod. 2014 May;84(3):516-20. doi: 10.2319/081413-600.1.

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Revolutionizing Conservative Dentistry And Endodontics With Ozone : Insights From A Literature Review

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Abstract

The oral cavity is an open space that has a dynamic balance between entry, colonization, and removal of microorganisms by the host defenses. To avert abolition, they stick to hard dental surfaces. Most common oral pathologies are associated with the formation and development of oral biofilm, which acts as a reservoir for selected microorganisms. Most of the pathogens contain very little amount of anti-oxidants in their membranes, due to which they are vulnerabletoozone.Inthisway,ozonedestroysthecellmembraneandreducestheinfection-causing bacteria. Conventional methods for detachment of microbial biofilm as well as deploying antibiotic disinfectants are now replaced by ozone therapy.

Ozone is a tri-atomic molecule (O3), that contains three O2molecules. It exhibits high reactivity, which acts like “an oxidant as well as an oxidizer”. It is more widely accepted since it is non-invasive, atraumatic, painless, and has fewer adverse effects. It is now been slowly replacing the conventional modes of treatment.

Thisarticlemainlyaimstodiscusstheroleofozoneinthemanagementofcertainorallesions as well as possible contributions to future healthcare solutions.

Keywords : Ozone (O3), Antimicrobialagents, Oozne therapy.

Introduction

Three oxygen atoms make up the natural gaseous molecule known as ozone. Ozone helps in the protection of living organisms from harmful ultraviolet rays. It is present in plenty of amounts in the stratosphere[1]. As it is heavier than air, it falls towards the earth[2]. In thisway, it combines with the pollutants and helps in naturally cleaning the earth[3]. Since it is a gas, it can enter into very small spaces of tissues that cannot be accessed easily. In themedical field, it can be used for the enhancement of circulation. Promotion of oxygen metabolism, as well as to destroy the disease-causing microorganisms[4]. Ozone-basedh-ealing treatment can be described as" Abroad-spectrumbio-oxidative therapy incorporating oxygen/ozone can be delivered in the form of gas or water as well as oil-based formulation; to achieve healing effects [5].

It is a three-atom molecular structure with a group of three O2atoms that bond together at an obtuse angle, i.e. 116oc. The internal stearic hindrance of the structure forbids of becoming full three-angled configuration[6]. The entire molecule is negatively charged[1].

The word 'Ozone' originally stems from the Greek word 'Ozein', signifying originally signifies fragrance. Christian Freidrich Schonbein (Founder of Ozone Oxidative Healing)[7], originally implemented ozone during the year 1840.

Experimented for over more than 100 years, it was first used for the disinfection of operating rooms in 1856, followed by its usage for blood purification in 1870[8].

In dentistry, it was first used by Dr. E.A. Fisch for the recovery of dental surgery wounds in the 1930's[9]. The primary aim of the therapy in dental profession depends Due to its abilityto combat microbes[10].

Forms of Application

Medically generated ozone is available in three forms, i.e. Gas, Ozonated water,

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and Ozonated oil base. An I/V injection of ozone should never be used to administer ozone, as there is a high chance to develop air embolism[11].

Ozoneissupplied andused in theform of agas, buthasso-melimitations on inhalation.

Water form of ozone is mainly used as an irrigant and mouth wash. And generally, considered a safe option than the gaseous systems.

Oilformofozoneismainlyusedfortopicalpurposes.Theadvantageofthismethodof delivery is that it is convenient as well as provides greater penetration.

Ozone Generating Systems

These are used to produce ozone which is therapeutically beneficial to humans. For use in the medical field, highly efficient Ozone generators are used for the generation of Ozone. Flowing of medically graded oxygen through very high voltage tubes having an output range between 4000 V - 14000 V leads to Ozone production. These apparat uses are based on following three concepts, i.e:

a. **Ultra Violet Light Lamp:** When exposed to UV light, the oxygen molecule absorbs energy on the ground state and disassociates into O2atoms. These subatomic particles subsequently merge with other O2molecular entities hence creating Ozone[12,13].
b. **Corona Discharge System:** Corona discharge is used for the passage of Oxygen where plasma is created. At first, only one Oxygen atom is created that attaches itself with other Oxygen molecules thus producing Ozone. The advantages of this system are that it produces well-regulated ozone discharge and simple to manage[13].
c. **Cold Plasma System[14-16]:** This system works on gas ionization of Oxygen. This takes place between the two electrodes, separated by dielectric separators. As voltage passes through the electrodes, an electrostatic field is formed which results in the splitting of Oxygen molecules into"atoms";whichinturncombinewithotherOxygenmolecule sto form Ozone[17].

Mechanism of Action

Thevarious mechanisms of actions of ozonetherapy includes:

Anti-Microbial Effects : In Bacteria- Ozone disintegrates the cell wall integrity of bacteria and causes their lysis.It causes the oxidation of phospholipids and lipoproteins[18].

In Fungi - It causes inhibition of cellular progressions to different phases (more prone- budding phase)[19].

In Virus - It causes a change in the procreation phase of viruses by breaking up cell-to-viral pathogen contact via peroxidation[20].

Activation of O2Metabolic activity: Ozone oxidative healing leads to escalating Kreb's Cycle which leads to more ATP production and leads to more O2[21].

Activation of the Immune System: It causes an increase in immune system by escalating formation of Interferons & IL2 which in turn causes an increase in immunological reactions[22]. This in turn also leads to immuno-stimulatory effects.

O3's Physiological impact on the human lung : Proximity to humanlung causes:

- Theme an airway resistance has increased. & particular resistance of the airways
- Heigh tenedrate of respiration
- Decreased tidal volume
- Increaseinmaximaltranspulmonarypressure[22].

Anti-Inflammatory & Analgesic Actions : Ozone enhances the product of various biologically active materials [IL, Leukotrienes, PGs, etc]. These help in reducing in flammation as well as have analgesic effects[23].

Anti Hypoxic effect : Ozone increases the Po2 in tissues, which in turn results in a better- transporting capacity of oxygen in the blood. A low dose of Ozone when administered multiple times leads to the activation of enzymes (like dehydrogenase peroxidases, glutathione, etc)[24].

Biosynthetic effect : Ozone increases the functionality of tissues thus in turn increasing their regeneration capacity. It also enables the activation of protein synthesis in cells. It causes the dilation of arteries and veins by secreting vasodilators[24].

The Rapeuticuses of Ozone inconservative Dentistry and Endodontics

1. **As Root Canal Irrigant**

   Ozone is used as an antimicrobial agent in endodontics. When it is used at recommended concentration and time, accurately in root canals after cleaning and shaping, it acts as a good irrigant[7]. Its antimicrobial efficacy is similar to 2.5% of NaOCl[25]. It can hence, be used in the non-surgical management of periapical lesions. “Ozone gas”, “ozonated water” and “oil” in Endodontics are mentioned in the literature[26,27].

   Encouraging results against pathogenic microbes were seen when ozonegas was circulatedin the canal at the frequency of 0.5-11/minute. The effective volume should be 5gm/ml for 2-3 mins.

   The University of Zagreb conducted a study that showed a significant reduction in thenumber of S.Mitis and P.Bacterium strains after ozone healing therapy[28].

2. **Dentin Hypersensitivity**

   Utilization of ozone healing therapy and later deployment of a remineralizing agent leads to a reduction in sensitivity. Itleadstoeradicatingtheextraneouslayer,leadingtoopenin gandwidening of dentinal tubules. When any remineralizing agent like calcium and fluoride is applied, they can easily enter the tubules completely and inhibits the exchange of fluids from these tubules.

   Application of ozone for the 40-60s helps in reducing the pain instantly. Various studies report that the effect of ozone treatment lasts longer than the conventional methods[29].

3. **Teeth Whitening**

Ozone is a potent material that can be used as a teeth-whitening agent. There are some studies, that suggest that after the use of ozone for teeth whitening procedures, there was a marked reduction in the tetracycline-induced yellowish hue on teeth [30]. According to -Al Omiri et al[31], which concluded that bleaching with this triatomic oxygen effected in brighter teeth when compared to bleaching with 38% H2O2.

4. **Management of Cavitary lesions**

- **Treating dental caries:** Ozone intervention for carious lesions leads to the marked elimination of caries-causing bacteria. There is the oxidation of pyruvic acid to CH3COO and CO2[32]. When the bacteria like streptococcus mutans and streptococcus Sorbinus were exposed to ozone, a marked decrease in the number of bacteria was seen[33].
- **Treating pit and fissure cavitary lesions:** In the extensive cavity and fissure carious lesions, the microorganisms residing in deep pits are difficult to remove. In suchcases, ozone application proves to be beneficial. The process begins with cleaning the fissures, followed by ozone application and remineralizing agent insertion. The application of ozone eliminates the smear layer and aids in halting fluid exchange, so closing fissures.[34].

  Huth et al conducted a study that concludes that the application of ozone to non- cavitated initial fissure caries improved their conditions over 3 months [35].
- **Management of root caries:** It has been seen that the application of ozone over root caries leads to significant reduction as well as slow down the development of root caries without removing it. Regular progressive application of ozone is recommended for the 40s followed by remineralizing agents[36].
- **Restorative dentistry:** Ozone application for a prolonged time possesses a potent bactericidal impact on microbes inside the tubular dentin that leads to an improved clinical success rate of restoration[37].

Despiteof having so many uses in dentistry, there are some contraindications and side effects associated with the ozone therapy. Some of them are listed below:

The ozone therapy is refrained amid some cases:

The ozone therapy is refrained amid some cases:	
AlcoholSaturation	Ozoneallergy
Hypochromia	Pregnancy
Autoimmune disorders	Thrombocytopenia
Hemorrhage	Immunocompromisedpatients
Hyperthyroidism	
Myasthenia	
Myocardialinfarction	

Side Effects of Ozone therapy

Side Effects :	
Epiphora	Headache
Rhinitis	Nausea and Vomitting
Cough	

Ozone Toxicity

Despite having so many benefits, ozone inhalation has injurious effects on human respiratory system as well as other organs.

According to "The European Cooperation of Medical Ozone Societies". [38] I/VshotsofO3gas have been forbidden as they can cause an increased risk of air embolism For the managing O3inebriation,patient'sairway ought to be maintained, patient must lie in a supine position, inhalation of oxygen-enriched moisture must be done, followed by Ascorbic acid administration to patient, along with Vitamin E and n-acetylcysteine[38].

Conclusion

Ozone healing therapy is equipped with numerous uses in virtually every area of dentistry. Immune response stimulants, pain relivers, anti-soporific, eliminating toxins, antibacterial, bioenergy, as well as biological synthesis effects are just a few of its special qualities. It is relatively painless, non-invasive, and atraumatic treatment modality. Therefore, has increased patient compliance.

The use of ozone is a rapidly expanding field with a lot of potential in dentistry. The effectiveness of ozone application in dental medicine is supported by various studies. The benefits of ozone healing therapy during restorative procedures are well documented in the literature. Nevertheless, the outcomes of diverse clinical trials typically present an effective alternative treatment strategy with few to no hazards. Numerous conditions, including sensitivity, root canal treatments, and jaw osteonecrosis, respond well to ozone therapy.

To ensure improved understanding of utilization of ozone in dental fields, standardized trials and further clinical research are needed.

Ozone therapy had much shorter treatment time and a more thorough bacterial eradication with few side effects. Patients report that the operation is painless and well tolerated.

In dentistry, it is proven to be minimally invasive and a cost-effective choice of treatment. It is a boon to curing numerous pathologies and improving the quality of treatment.

References

1. Gujjari GK, Gujjari AK, Patel PV, Shubhashini PV. Comp-arative evaluation of ultraviolet and microwave techni-ques for toothbrush decontamination. J Int Soc Prev Com-munity Dent 2011;1:20.
2. GargR, TandonS. Ozone : anew face of dentistry. IntJDent Sci2009;7:2.

3. Kagan J. Are You Ready For This – Ozone Therapy. Ozone Information for Clinicians, 2003.
4. Meena A, Trivedi HP, Gupta M, Parvez S, Likhyani L. Therapeutic applications of ozonated products. Int J Dent Clin 2011;3:68-9.
5. Bocci V. Ozone as Janus: this controversial gas can be either toxic or medically useful. Mediators Inflamm 2004;13(1):3–11.
6. Patel, Kumar V, Gujjari S, Vidya GD, Patel Amrita. Thera-peutic effect of topical ozonated oil on epithelial healing of palatal wound site: a planimetrical and cytological study. J. Clin. Investig. Dent. 2011;2:248–58.
7. Tiwari S, Avinash A, Katiyar S, Iyer A, Jain S. Dental applications of ozone therapy: A review of literature. Saudi J Dent Res 2017;8:105-11.
8. Chemical Technology: An Encyclopedic Treatment, vol. 1. New York: Barnes & Noble. 1968:82-83.
9. Srikanth A, Sathish M, Sri Harsha AV. Application of ozone in the treatment of periodontal disease. J Pharm Bioallied Sci. 2013;5:S89-S94.
10. GreeneAK, FewBK, SerafiniJC. Acomparison of ozonation and chlorination for the disinfection of stainless steel surfaces. J Dairy Sci 1993;76(11):3617–20.
11. article5ka description
12. BeggsR. Reliable caries reversal: an other paradigmshift? Dent Today.2004;23:14-6.
13. Komali G. Ozone therapy-a revolutionary noninvasive therapy in dentistry. Open Access SciRep. 2012;1:473.
14. Schonbein C. Notice of C Sch., the discoverer of ozone. Annual Report of the Boardof Regents of the Smithsonian Inst., 1868. Washington, DC: US Government Printing Office;1869. p. 185–92.
15. WolffH. Das MedizinischeOzon. Heidelberg: VFM Publications;1979.
16. 14. Payr E. Uber ozon be hand lung in der chirurgie. Munch med Wschr1935;82:220– 91.
17. MakkarS, MakkarM. Ozone-treatingdentalinfections.IndianJ Stomatol.2011; 2:256- 259.
18. Broadwater WT, Hoehn RC. Sensitivity of three selected bacterial species to ozone. ApplMicrobiol 1973; 26 (3): 391–3.
19. Bocci V. Autohaemotherapy after treatment of blood with ozone.A reappraisal. J Int Med Res 1994;22(3):131–44.
20. ElvisAM, EktaJS. Ozonetherapy: aclinicalreview. JNat SciBiolMed 2011;2(1):66–70.
21. Chang Hubertetal. Oxidative consumption of oral biomolecules by therape utically- relevant doses of ozone. Adv Chem Eng Sci2012;2:238–45.
22. WerkmeisterH. Subatmospheric 02/03 treatment of therapy resistant wounds and ulcerations. Ozo Nachrich-ten 1985;4:53–9.\
23. Kumar A, Bhagawati S, Tyagi P, Kumar P. Current interpretations andscientific rationaleof the ozone usage in dentistry: A systematic reviewof literature. Eur J Gen Dent 2014;3:175-80.
24. LynchE. Leczenie próchnicyzwykorzy staniem systemuHeal Ozon. eDentico. 2004;134:3.
25. Reddy SA, Reddy N, Dinapadu S, Reddy M, Pasari S. Role of ozone therapy in minimal intervention dentistry and endodontics – A review.J Int Oral Health 2013;5:102-8.
26. Siqueira Jr JF, Rocas IN, Cardoso CC, Macedo SB, Lopes HP. Antibacterial effects of anew medicament- the ozoni-zed oilcompared to calcium hydroxide pastes. Rev Bras Odontol 2000;57:252–6.
27. Silveira AM, Lopes HP, Siqueira Jr JF, Macedo SB, Conso-laro A.Periradicular repair aftertwo-visit endodontic treatment using two different in tracanal medications compared to single-visit endodontic treatment. Braz Dent J 2007;18:299–304.
28. HalbauerK, PrskaloK, JankovicB, TarleZ, PanduricV, KalenicS. Efficacyof ozone onmicroorganisms in the tooth root canal. Coll Antropol. 2013;37:101-107.
29. GargR,TandonS.Ozone: anewfaceofdentistry. InternetJ DentSci 2009;7:2.
30. Tessier J, Rodriguez PN, Lifshitz F, Friedman SM, Lanata EJ. The use of ozone tolighten teeth: An experimental study. Acta Odontol Latinoam. 2010;23:84-89.
31. NogalesCG,FerrariPH,KantorovichEO,Lage-MarquesJL. Ozonetherapyinmedicine and dentistry. J Contemp Dent Pract. 2008;9:75-84.
32. KumarA, BhagwatiS, TyagiP, KumarP. Currentinter pretationandrationaleofthe ozone usage in dentistry: a syste-mic review of literature. Eur J Gen Dent 2014;-3(3): 17580.
33. Baysan A, Whiley RA, Lynch E. Antimicrobial effect of a novel ozone– generating device on micro–organisms associated with primary root carious lesions in vitro. CariesRes. 2000;34:498-501.
34. Reddy SA, Reddy N, Dinapadu S, Reddy M, Pasari S. Role of ozone therapy in minimalintervention dentistry and endodontics – a review. J Int Oral Health 2013 Jun; 5(3):102–8.
35. Huth KC, Paschos E, Brand K, Hickel R. Effect of ozone on non cavitated fissure carious lesions in permanent molars -a controlled prospective clinical study. Am J Dent 2005;18:223–8.
36. Holmes J. Clinical reversal of root caries using ozone, double blind, randomized control 18 month trial. UKSm-iles Dental Practice. Gerodontology 2003;20:106–14.
37. Polydorou O, Pelz K, Hahn P. Antibacterial effect of an ozone device and its comparison with two dentin-bonding systems. Eur J Oral Sci 2006;114(4):349–53.
38. Estrela C, Estrela CR, Decurcio DA, Hollanda AC, Silva JA. Antimicrobial efficacy of ozonated water, gaseous ozone, sodium hypochlorite and chlorhexidine in infected human root canals. Int Endod J 2007;40:85-93.

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Digital Smiledesign In Aesthetic & Conservative Dentistry

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Abstract

In modern dental practice many patients seek cosmetic enhancements for their anterior teeth to improve their smile for aesthetics. To facilitate the planning processdentists utilize image processing tools that simulate the expected outcomes for various treatments. Digital Smile Design (DSD) software is an intuitive and efficient tool that enables clinicians to digitally visualize potential restorations on a patient's profile photographenhancing aesthetic treatment predictability.

Keywords : Digital Smile Design, Digital Smile Design Software, Aesthetics, Treatment Planning, Dentistry

Introduction

Smile Designing Softwares are a revolutionary tool that has transformed the field of aesthetic and conservative dentistry, enabling dentists to create beautiful and functional smiles with precision and accuracy.[1] As noted by Kokich et al. (2019), "digital smile design has become an essential tool in modern dentistry, allowing dentists to communicate effectively with patients and achieve predictable results." According to another author Spear et al. (2020), "the use of digital smile design software has improved the accuracy and efficiency of aesthetic and conservative dentistry." As stated by Chiche et al. (2018), "Smile Design Software has become a valuable tool in aesthetic and conservative dentistry, enabling dentists to create personalized smile designs that meet the unique needs and preferences of each patient." Additionally in (2017) Coahmenetal noted that "Smile Design Software is a powerful tool for aesthetic and conservative dentistry allowing dentists to create aesthetic, beautiful and functional smiles with accuracy."[2]

What Is Smile Design Software?

Smile Design Software is a digital platform that allows dentists to create customized smile designs for their patients, taking into account their facial structure, teeth, and gums. As explained by Calamia et al. (2019), "Smile Design Software uses advanced algorithms and artificial intelligence to analyze the patient's facial structure and create a personalized smile design that is proportional and harmonious."[3,4] According to Magne et al. (2020), "Smile Design Software has been shown to improve the accuracy and efficiency of aesthetic and conservative dentistry, reducing the risk of human error and improving patient satisfaction." Furthermore, Gurel et al. (2019) noted that "Smile Design Software is a valuable tool for aesthetic and conservative dentistry, enabling dentists to create personalized smile designs that meet the unique needs and preferences of each patient."[5]

Key Features Of Smile Design Software

Some of the key features of Smile Design Software include:[6,7]

1. **Facial Analysis :** Evaluates the patient's facial structure, including the shape of the face, lips, and nose, to ensure a proportional and harmonious smile design.
2. **Tooth Analysis :** Examines the patient's dental characteristics, including tooth size, shape, and color, to create aesthetically functional restorations.
3. **Gum Analysis :** Assesses gum contours and pigmentation to ensure a healthy

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and natural-looking smile.

4. **Smile Simulation :** Generates a 3D visualization of the patient's smile, allowing a preview of the expected outcome before treatment
5. **Treatment Planning :** Assists in designing and implementing the required dental treatments to achieve the proposed smile enhancement.

Benefits of Smile Design Software

The benefits of using Smile Design Software in aesthetic and conservative dentistry include:[8,9]

1. **Increased Accuracy :** The software provides accurate and precise measurements, reducing the risk of human error.
2. **Improved Patient Satisfaction :** The software allows patients to see their new smile before any treatment is performed, increasing their satisfaction and confidence in the treatment.
3. **Enhanced Communication :** The software facilitates communication between the dentist and patient, ensuring that everyone is on the same page.
4. **Reduced Treatment Time :** The software helps to streamline the treatment process, reducing the time and number of appointments needed to achieve the desired results
5. **Increased Efficiency :** The software automates many of the tasks involved in aesthetic and conservative dentistry, freeing up time for the dentist to focus on other aspects of patient care.
6. **Improved Patient Outcomes :** The software has been shown to improve patient outcomes, including increased patient satisfaction and reduced treatment time.

Discussion

The integration of Smile Design Software into aesthetic and conservative dentistry has revolutionized the field, setting a new standard for precision, efficiency, and patient-cente-red care.[10] This discussion highlights the implications, advant-ages, and considerations associated with the adoption of this technology.

1. Advancements in Patient Care[10,11]

Smile Design Software offers unparalleled accuracy by utilizing advanced algorithms and artificial intelligence. This precision enables dentists to create tailored treatment plans that align with a patient's unique facial structure, dental characteristics, and aesthetic preferences. The ability to visualize outcomes through 3D smile simulations significantly enhances patient confidence and satisfaction. As noted by Calamia et al. (2019), this simulation fosters a collaborative approach where patients actively participate in their treatment journey, improving communication and alignment of expectations.

2. Enhanced Efficiency and Accuracy10,11

Traditionally, aesthetic dentistry required extensive manual work and trial-and-error methods, often leading to inconsistent outcomes and longer treatment times. With Smile Design Software, the process is streamlined, reducing human error and minimizing unnecessary revisions. Studies by Magne et al. (2020) and Coachman et al. (2017) confirm that this software increases efficiency by automating crucial tasks like facial and dental analysis, making it a reliable tool for both diagnosis and treatment planning. AI generated digital mock-ups can be really beneficial for the patient smile designing.

3. Communication and Collaboration[8,10]

A key benefit of Smile Design Software is its ability to enhance communication not only between dentists and patients but also among interdisciplinary teams. For instance, orthodontists, periodontists, and prosthodontists can collaborate seamlessly using the software's shared data and visualizations. This collaborative approach ens-ures a holistic and well-integrated treatment plan, impro-ving overall patient outcomes.

4. Overcoming Challenges[8,11]

Despite its many advantages, there are challenges associated with Smile Design Software. The initial cost of the software and the learning curve for effective utilization can be barriers for smaller practices. Additionally, the reliance on technology requires regular updates and maintenance, which can increase long-term operational costs. Dentists must also balance technology with clinical judgment, ensuring that digital solutions complement rather than overshadow their expertise.

5. Future Directions[11]

As Smile Design Software continues to evolve, it is likely to incorporate more sophisticated features such as augmented reality (AR) for real-time treatment simulations and deeper integration with 3D printing for prosthetic and restorative applications. Furthermore, advancements in AI could enhance predictive capabilities, providing even more accurate simulations of long-term outcomes.

Conclusion

The integration of Smile Design Software into aesthetic and conservative dentistry represents a transformative shift, offering improved accuracy, efficiency, and patient satisfaction. Although challenges such as cost and training exist, the long-term benefits significantly outweigh the initial investment. With ongoing technological advancements, Smile Design Software is set to become a fundamental component of modern dentistry, shaping the future of aesthetic treatments and enhancing overall patient care. Further research and innovation will continue to expand its potential, solidifying its role in achieving superior dental outcomes.

References

1. SarraNasri, YosraGassara, Rim Kallala, RihabDakhli, Zohra Nouira, JilaniSaafi, MounirCherif, Belhassen Harzallah. Digital Smile Design Software: An Overview. Sch J Med Case Rep, 2024 Nov 12(11): 1866-1868
2. Jafri Z, Ahmad N, Sawai M, Sultan N, Bhardwaj A. Digital Smile Design-An innovative tool in aesthetic dentistry. J Oral BiolCraniofac Res. 2020 Apr-Jun;10(2):194-198.
3. Soo, Steven et al. "Aesthetic Digital Smile Design: Software-aided aesthetic dentistry - Part II." (2018).
4. Alharkan, Hamad. (2023). Integrating Digital Smile Design into Restorative Dentistry: A Narrative Review of the Applications and Benefits. The Saudi Dental Journal. 36. 10.1016/j.sdentj.2023.12.014.
5. Madhu, Priyanka &Reche, Amit. (2023). Digital Smile Design- An Overview of 3D Digital Workflow. Journal Of Clinical And Diagnostic Research. 17. 10.7860/ JCDR/ 2023/61467.17386.
6. Jafri Z, Ahmad N, Sawai M, Sultan N, Bhardwaj A. Digital Smile Design-An innovative tool in aesthetic dentistry. J Oral BiolCraniofac Res. 2020 Apr-Jun;10(2):194-198.
7. Cervino G, Fiorillo L, Arzukanyan AV, Spagnuolo G, Cicciù M. Dental Restorative Digital Workflow: Digital Smile Design from Aesthetic to Function. Dent J (Basel). 2019 Mar 28;7(2):30.
8. Coachman, Christian &Calamita, Marcelo & Ricci, Andrea. (2018). Digital Smile Design: A Digital Tool for Esthetic Evaluation, Team Communication, and Patient Manage-ment. 10.1002/9781119272946.ch4.
9. Luca, E., Iordache, C., Tanculescu, O., Surlari, Z., Virvescu, D., Checherita, L., ... &Beldiman, M. (2019). Aspects of aesthetic rehabilitation using digital smile design. Romanian journal of oral rehabilitation, 11(2), 119-123.
10. Omar, D., Duarte, C. The application of parameters for comprehensive smile esthetics by digital smile design programs: A review of literature. The Saudi Dental Journal (2017).
11. Trushkowsky R, Arias DM, David S. Digital Smile Design concept delineates the final potential result of crown lengthening and porcelain veneers to correct a gummy smile. Int J Esthet Dent. 2016 Autumn;11(3):338-54.

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Tooth Coloured CAD/CAM PMMA Crown In A Primary Molar : A 10 Months Follow-Up

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Abstract

Preformed crowns are part of the armamentarium in Pediatric dentistry. In recent years, aesthetic alternatives to preformed metal crowns such as pre-veneered, zirconia and PMMA crowns have been developed. This paper describes the restoration of a pulpally treated primary molar with a preformed CAD/CAM PMMA crown in a 9-year-old boy over a10 month follow-up period. At the end of the observation period the retentivity of the PMMA crown, the gingival response and the wear on the opposing tooth were considered on the basis of a predefined criteria. It was concluded that the Pediatric CAD/CAM assisted PMMA crown allowed sustainable functional restoration while restoring natural appearance of the tooth.

Key Words : CAD/CAM, PMMA crown, Aesthetics, Primary Molar

Introduction

Stainless steel crowns have been the gold standard in restoring pulpally treated primary molars[1] but owing to the metallic appearance, higher aesthetic zirconia crowns with superior clinical performance have emerged as a better treatment option. However, their usage is limited due to inadequate documentation of the benefits of zirconia crowns and wear of opposing tooth due to higher compressive strength of the material.[2]

Therefore, a material is required which can fulfil the need of full coverage and aesthetics while being more economical than zirconia. In recent years, digital dentistry has rapidly developed, especially computer-aided design and manufacturing (CAD/CAM) with different types of biocompatible restorative materials.[2] Preformed CAD/CAM crowns formulated from PMMA (Polymethyl methacrylate) blanks are an option for extra coronal restorations in primary dentition. The unique properties ofthese crowns, such as low density, high aesthetics, cost-effectiveness, ease of manipulation, tailorable physical and mechanical properties,[3] good wear resistance, high polishability, color stability, good marginal fit with optimal strength, and biocompatibility with the oral tissues[4] make them suitable and popular biomaterial in Pediatric dentistry.

Case Presentation

A 9-year-old boy accompanied by his parents came to the Department of Pedodontics & Preventive Dentistry with a chief complaint of pain in lower left back region. Radiographic examination revealed a carious lesion involving pulp in-relation-to 74. Treatment included pulpectomy with full-coverage crown. Parents were explained about the treatment options and a written consent was taken before the procedure. As parents were highly concerned with the aesthetic appearance and having financial constraints at the same time, it was decided to use our in-house CAD/CAM laboratory for preparing PMMA crown for a pulpectomy treated tooth.

An appropriate crown size was selected prior to the tooth preparation by measuring the mesiodistal dimension.(Figure-1) In this case, we used a standard crown size of 4 (3M ESPE) as reference.

Occlusal preparation of 1.5-2 mm was done using the marginal ridge of the adjacent tooth as a reference point.

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Proximal preparation of 0.5–1.25mm around the circumference, following the natural contour of the original tooth was done. Subgingival preparation of approximately 1–1.5mm below the CEJ, avoiding damage to the gingival tissues was done. All sharp line and point angles were rounded off.

Crown trial was done clinically before cementation owing to the inflexible nature of the crowns. A proper marginal fit of the crown was achieved by reducing the bucco-lingual thickness of the margins. An advantage of the fact that PMMA can be trimmed & polished, both the internal and external surfaces of the crown were adjusted chairside.

The tooth and crown were cleaned of all the blood and saliva residues prior to cementation. A self-adhesive resin cement (Densplysironacalibra universal) was used for luting. (Figure-2:a,b) A monthly check-up appointment was scheduled for the patient, however he came after 10 months as he failed to report to the department earlier.

At the end of 10-months, crown was evaluated based on 3 parameters. Retention was clinically evaluated by visual assessment, according to the USPHS, alpha criteria rating system.[5] Gingival response was checked by Loe and Silness index (1967)[6]. Occlusal wear on the opposing tooth was assessed by Smith and Knight Tooth Wear Index.[7] In this case the PMMA crown was performing well on all the criteria with a score alpha in USPHS, alpha criteria rating system, score 0 in both Loe and Silness index and Smith and Knight Tooth Wear Index.

Discussion

In light of this clinical scenario, an alternate treatment option for restoring pulpally-treated primary molar needing full-coverage crown within acceptable cost range and aesthetic appearance has been highlighted. Several researchers have investigated the use of CAD/CAM technologies for the fabrication of PMMA dental prostheses using rapid prototyping and milling techniques[3] which shows superiority in terms of several properties, including hardness, flexural strength, impact strength and durability.[3] Good clinical retention and durability of the pre-formed milled PMMA crown were one of the positive observation of this case. The aesthetic appearance was natural and clinically acceptable. The main advantage of CAD/CAM Pre-fabricated PMMA crown as described by Pascutti et al is it's ease in fabrication, along with less chairside time consumption and cost-effectiveness.[8] Resistance to occlusal wear is an important consideration for the clinical success of oral prosthetic restorations. The wear of the restorative material should match with that of natural enamel.[9] In our case, wear patterns on the PMMA crown were seen on occlusal surface along with chipping on distolingual margin during the 10-month follow-up period. (Figure-3) At the same time no accelerated occlusal wear was seen on opposing intact natural tooth.(Figure-4) This finding is consistent with that of Claudia Florina Andreescu who mentioned that CAD/CAM fabricated milled crowns possess good fracture resistance as they have almost zero porosity and high homogenisity.[8] Two disadvantages perceived preoperatively were higher thickness of PMMA crown than preformed metal crown and a need for subgingival preparation wherever necessary. These aspects could influence the gingival response and health. However, in this case no gingival inflammation was noted around the crown as the patient maintained good oral hygiene through out the follow-up period. This finding is in tune with the fact that when the oral hygiene is maintained properly, there is no noticeable gingival inflammation.[10] Further advantage of this material is enhanced hydrophobicity and specific surface properties[3] resulting in inhibition of plaque accumulation,[4] leading to good gingival response. Along the same line, Atayet al.[4] also pointed out that new generations of CAD/CAM milled PMMA can safely be used in clinical conditions. As a result, PMMA has emerged as a suitable material for prefabricated crowns to be used in pediatric patients. However, an evaluation of the long-term success of these crowns is definitely needed, with more clinical cases in different scenarios.

Conclusion

In this case, Preformed crown prepared with PMMA blank using in house CAD/CAM milling procedure has shown good performance over a 10-month follow-up period.

References

1. Kindelan SA, Day P, Nichol R, Willmott N, Fayle SA; British Society of Paediatric Dentistry. UK National Clinical Guidelines in Paediatric Dentistry: stainless steel preformed crowns for primary molars. Int J Paediatr Dent 2008;18(1):20–28.
2. Mohammed Nour Al-Halabi, Nada Bshara, Jihad Abou Nassar, John C. Comisi, Charline K. Rizk. Clinical Performance of Two Types of Primary Molar Indirect Crowns Fabricated by 3D Printer and CAD/CAM for Rehabilitation of Large Carious Primary. Molar.Eur J Dent. 2021 Jul; 15(3): 463–468.
3. Zafar MS. Prosthodontic Applications of Polymethyl Methacrylate (PMMA): An Update. Polymers. 2020; 12(10):2299.
4. Pituru SM, Greabu M, Totan A, Imre M, Pantea M, Spinu T, et al. A Review on the Biocompatibility of PMMA-Based Dental Materials for Interim Prosthetic Restorations with a Glimpse into their Modern Manufacturing Techniques. Materials (Basel). 2020 Jun 28;13(13):2894.
5. Ryge G. Clinical criteria. Int Dent J. 1980;30:34–58.
6. Löe H. The Gingival Index, the Plaque Index and the Retention Index Systems. J Periodontol. 1967 Nov-Dec;38(6):610-616.
7. Smith BG, Knight JK. An index for measuring the wear of teeth. Br Dent J 1984;156:435–438.

8. BodhisattaMukherjeea, Upasana Panda B, Gautam Naskarc, Monika Samald, Gopal Krishna Choudhury E. A comparative analysis of wear resistance, surface hardness and fracture resistance of interim restoration fabricated by cad/cam and conventional method. Eur. Chem. Bull. 2023,12(6):856–864.
9. Meghana Reddy J, Ashok V, Kiran Kumar and Dhanraj Ganapathy. Comparative Evaluation of Wear Resistance Among Cad-Cam and Resin Interim Restoration - an in Vitro Study. Bioscience Biotechnology Research Communication 2020; 13 (8):224-228.
10. Lopez Cazaux S, Hyon I, Prud'homme T, et al. Twenty-nine-month follow-up of a paediatric zirconia dental crown. BMJ Case Rep 2017.

Figure-1 Intraoral pre-operative clinical photo

Figure-2 : a Intra-oral view immediately after PMMA crown cemented

Figure-2 : b Occlusal relation after cementation

Figure-3 Clinical photo at 10 month follow-up

Figure-4 Intact opposing toothat 10 month follow-up

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Artificial Intelligence (AI) In Conservative Dentistry And Endodontics

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Abstract

Artificial intelligence (AI) is revolutionizing conservative dentistry and endodontics by enhancing diagnostic precision, treatment planning, and patient management. This article explores AI's role in these specialties, focusing on its impact on caries detection, endodontic diagnosis, and predictive analytics. While AI holds great promise in improving clinical efficiency, its integration faces challenges, including data standardization, ethical concerns, and technological adaptation. Ongoing researchadvancements are essential for its successful application in modern dental practices, ultimately improving patient outcomes.

Keywords : Artificial intelligence,Conservative Dentistry, Endodontics, Machine Learning, Deep Learning, Neural Networks

Introduction

Artificial intelligence (AI) refers to the capability of machines to simulate human intelligence, particularly in data processing, pattern recognition, and decision-making. In healthcare, AI has emerged as a powerful tool in diagnostics, treatment optimization, and patient care. Within dentistry, AI applications utilize machine learning (ML), deep learning (DL), and artificial neural networks (ANNs) to analyze complex datasets and improve clinical decision-making [1].

Conservative dentistry focuses on preserving natural dentition by diagnosing and managing dental caries and other restorative concerns, while endodontics specializes in treating diseases of the dental pulp and periapical tissues. Traditional diagnostic techniques, such as clinical examinations and radiographic assessments, are often limited by human interpretation variability. AI-driven technologies offer a more objective, consistent, and data-driven approach, reducing diagnostic errors and enhancing treatment precision [2].

Over the past decade, AI's role in dentistry has expanded significantly, particularly with the application of convolutional neural networks (CNNs) in endodontic imaging and ANNs for predicting treatment outcomes [3]. These technologies provide invaluable assistance to dental practitioners by offering real-time, data-driven insights that enhance accuracy and efficiency.

Despite AI's growing significance, several challenges hinder its full integration into routine dental practice. Data quality, interoperability, technological adaptation, and ethical considerations must be addressed to ensure the responsible use of AI in dentistry. This article explores the various applications of AI in conservative dentistry and endodontics, discusses its benefits and challenges, and examines future directions for research and practice.

Discussion

AI Applications in Conservative Dentistry and Endodontics

1. Enhancements in Diagnostics

AI-based systems have demonstrated significant improvements in diagnosing dental conditions:

Caries Detection : AI-driven deep learning models have shown remarkable accuracy in detecting dental caries from radiographic and intraoral images. These systems enable early diagnosis, minimizing the risk of disease progression and ensuring timely intervention [4].

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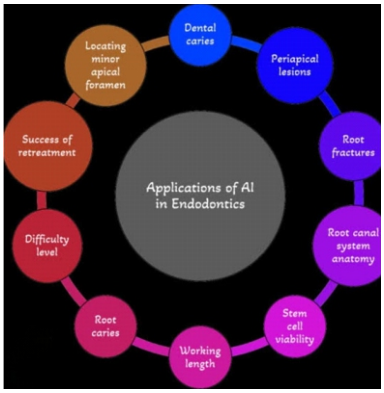
Identification of Periapical Pathologies : AI models, particularly CNNs, have been successfully used to analyze radiographs and identify periapical lesions, assisting in early diagnosis and effective treatment planning [5].

Detection of Vertical Root Fractures : Diagnosing vertical root fractures remains challenging using traditional methods. AI-powered image processing helps detect these fractures with higher precision, aiding in better clinical decision-making [6].



2. Treatment Planning and Prognostic Predictions

AI plays a crucial role in optimizing treatment strategies and predicting clinical outcomes:

Root Canal Anatomy Assessment : Understanding the complexity of root canal systems is essential for successful endodontic therapy. AI algorithms enhance accuracy in assessing root canal morphology, reducing the risk of missed canals and inadequate cleaning [7].

Working Length Determination: Accurate working length measurement is crucial for effective endodontic treatment. AI-based machine learning models analyze radiographic images to improve precision in working length estimation, leading to better treatment outcomes [8].

Prediction of Retreatment Success: AI systems evaluate multiple clinical parameters to predict the likelihood of successful endodontic retreatments, allowing practitioners to make informed decisions and personalize treatment approaches [9].

3. Technological Innovations in Dental Procedures

The integration of AI with robotics has led to notable advancements in dental treatments:

Automated Dental Procedures : AI-powered robotic systems assist in performing dental procedures with high precision. Technologies integrating AI with 3D imaging allow for more efficient crown placements and other restorative treatments, improving patient care and reducing chairside time [10]

4. Benefits of AI in Dentistry

The adoption of AI in dental practice offers numerous advantages: Enhanced Diagnostic Accuracy. AI algorithms analyze vast datasets to identify patterns and anomalies, reducing the margin of human error and improving early disease detection [11].

Improved Efficiency : AI-driven automation streamlines administrative tasks, such as appointment scheduling and patient record management, allowing practitioners to focus on complex cases [12].

Cost Reduction : By improving diagnostic accuracy and minimizing procedural errors, AI integration helps lower costs associated with additional tests and unnecessary interventions [13].

Patient-Centered Care : AI tools enhance patient education by providing visual simulations of treatment outcomes, fostering better communication and informed decision-making [14]

5. Challenges in AI Implementation

Despite its potential, several challenges hinder AI's widespread adoption in conservative dentistry and endodontics:

Data Standardization : AI models rely on high-quality, standardized datasets. Variability in imaging techniques, patient demographics, and clinical protocols makes standardization difficult [15].

Technical Training and Expertise : Successful AI integration requires specialized training for clinicians to operate and interpret AI-generated data accurately [6].

Financial Constraints: The implementation of AI-enabled technologies demands significant investment in infrastructure, which may be a barrier for smaller dental practices [12].

Ethical and Legal Concerns: AI raises important ethical issues, including data privacy, informed consent, and accountability in clinical decision-making. Regulations must evolve to ensure ethical AI usage [14].

Risk of Over-Reliance on Technology : While AI enhances clinical decision-making, excessive dependence on AI may reduce the development of critical diagnostic skills among practitioners. AI should be used as an adjunct rather than a replacement for human expertise [15]

Conclusion

AI is transforming conservative dentistry and endodontics by enhancing diagnostic accuracy, improving treatment planning, and optimizing patient care. While its integration presents challenges, the benefits outweigh the barriers, paving the way for a future where AI complements clinical expertise. Continued research, ethical considerations, and collaborative efforts will be crucial in ensuring the successful adoption of AI in modern dental practice.

References

1. Topaloglu B, Kose C. Artificial intelligence in endodontics: Applications and challenges. J Clin Dent. 2022;45(2):95-102.
2. Russel JE, Chen MP. AI-assisted diagnosis of periapical

lesions: A systematic review. Int J Dent Res. 2023; 38(1):56-65.

3. Vinayahalingam S, et al. Deep learning in root canal therapy. J Dent Appl. 2021;8(3):215-222.
4. Kohli P, et al. AI-driven caries detection: A game-changer in dentistry. Clin Oral Investig. 2021;25(6):3315-3323.
5. Chen Y, et al. The role of convolutional neural networks in dental imaging. Oral Radiol J. 2023;39(2):89-97.
6. Brizuela C, et al. Clinical outcomes of AI-assisted endodontic treatments. J Dent Res. 2023;102(7):894-900.
7. Zhang S, et al. A comprehensive review of AI in conservative dentistry. J Adv Dent Sci. 2023;10(4):123-134.
8. Duan Y, et al. Machine learning in root canal length estimation. ComputBiol Med. 2022;147:105742.
9. Ahmed HMA, et al. Predictive analytics in endodontic retreatment using artificial neural networks. Endodontics Today. 2023;12(1):12-19.
10. Lee JH, et al. AI-based automated dental procedures: Current trends and future directions. Robotics Healthc. 2022;15(3):45-58.
11. Park J, et al. Enhancing endodontic diagnostics with AI. IntEndod J. 2022;55(5):423-431.
12. Brizuela, C., et al. (2023). Clinical outcomes of AI-assisted endodontic treatments. Journal of Dental Research, 102(7), 894-900.
13. Duan, Y., et al. (2022). Machine learning in root canal length estimation. Computers in Biology and Medicine, 147, 105742.
14. Alvarez, R., et al. (2023). AI-based predictive models in conservative dentistry. Journal of Dental Analytics, 9(2), 78-87.
15. Santos, M. P., et al. (2023). Challenges in integrating AI into dental education and practice. Journal of Dental Education, 87(8), 923-932.

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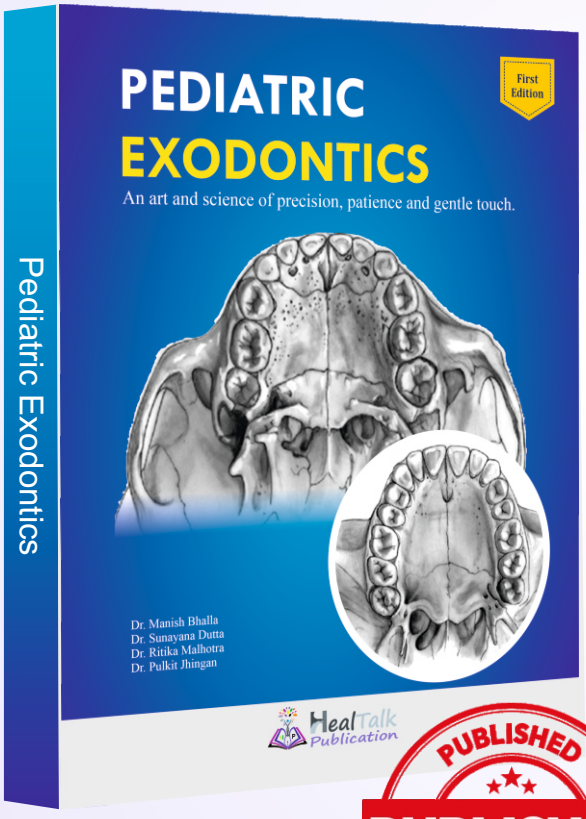

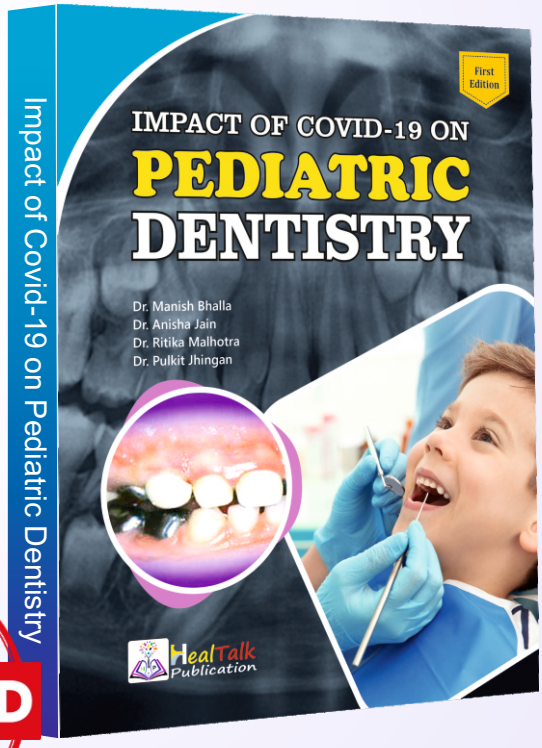

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