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Effect of drug abuse on oral and periodontal health - An overview of the literature

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Abstract

Drug abuse is a serious public health concern that affects not only the general well-being of individuals but also their oral and periodontal health. This literature review aims to summarize and compare the current and past evidence on the effects of various drugs on the oral cavity and adjacent tissues. The review sheds light on the following aspects: the prevalence and patterns of drug abuse in different countries and populations, the clinical manifestations, and the diagnosis of drug-related oral conditions by oral healthcare professionals; and the implications for dental practice and public health policies worldwide. This review covers studies published from 2000 to 2023 that examined the oral and periodontal health outcomes of various drugs specifically methamphetamine, cannabis, and alcohol. This review reveals that drug abuse has significant negative impacts on oral and periodontal health, such as dental caries, periodontitis, tooth loss, oral mucosal lesions, and oral cancer. Thus it concludes that dental professionals are key in screening, educating, and treating patients with drug-related oral conditions. Furthermore, the review highlights that dental professionals can advocate for better access and coverage of oral health care for drug abusers in collaboration with other health care providers and stakeholders in addressing the multifaceted challenges surrounding drug abuse.

Keywords: alcohol, cannabis, dental professional, drug abuse, methamphetamine, oral health, periodontal health.

Introduction

Abuse of substances such as cannabis, alcohol, and illicit drugs like Methamphetamine is an emerging global oral health crisis. In 1992, the WHO described the term drug addiction as "a psychic or physical state formed as an interaction between a living organism and a drug, resulting in behavioral responses that include the obligation to take the drug regularly to encounter its psychic effects and sometimes to avoid the discomfort of its absence". ¹ As of today drug abuse prevails as one of the world's most destructive oral health problems, a leading cause of violent, risky behaviors and social

issues.²⁻³ According to the worldwide drug report, in 2020, an estimated 284 million people worldwide aged 15-64 had used a drug within the last 12 months. The majority was seen in males. This corresponds to approximately 1 in every 18 people in that age group, or 5.6 percent, and represents a 26 percent increase in 2010 when the estimated number of people who used drugs was 226 million and prevalence was 5 percent. Qualitative information suggests that 2020 saw an overall increase in the use of cannabis – still by far the world's most-used drug - and in the use of amphetamines. A World Health Organization report published in 2018 estimated that there are 2.3 billion alcohol consumers across the globe. Substance Abuse and Mental Health Services Administration reports in 2021 correlated heavy alcohol and illicit drug intake to serious health problems.⁴

The latest survey (2022) highlighting the drug situation in the European Union reports that approximately 83.4 million or 29 percent of adults in the age group of 15 -64 years are estimated to have ever used an illicit drug, with more males (50.5 million) than females (33.0 million) reporting use. Cannabis remains the most popularly consumed substance, with over 22 million European adults reporting its use in the last year followed by 2 million amphetamine consumers.⁵ According to the latest report prepared by Global Synthetics Monitoring: Analyses, Reporting, and Trends (SMART) Programme, Laboratory and Scientific Service with the support of the UNODC Regional Office for Southeast Asia and the Pacific, the drug issue in East and Southeast Asia is a growing concern with these regions being amongst the world's largest methamphetamine markets. A Comprehensive National Survey on the Extent and Pattern of Substance Use in India conducted by The Ministry of Social Justice and Empowerment in 2018 estimated that approximately 150 million adults (males and females) in the age group of 18 - 75 years abused alcohol, the prevalence being 17 times higher in men than women. 20 million adults abused cannabis; the least abused at 1.5 million is Methamphetamine. Chhattisgarh, Punjab, Uttar Pradesh, and Delhi are the top states in India reporting higher than the national average in terms of prevalence of drug abuse.

Prolonged use of abused substances has destructive and injurious effects on oral health. These substances contribute to decreased salivary flow in the mouth, a condition called 'xerostomia' or 'dry mouth' increasing the incidence of dental caries.⁶⁻⁷ Studies have also reported higher incidences of mucosal lesions like oral leukoedema, leukoplakia, oral submucous fibrosis, hyperkeratosis, oral cancer, and fungal infections like Candida Albicans.⁷⁻⁸ The oral cavity of such patients is prone to developing uvulitis and oral papillomas.^{7.9} Decayed, broken, and missing teeth have been reported in large numbers.¹⁰ Moreover, dental wear and dental erosion are prevalent findings.^{7,11} Jaw clenching, sore TMJ muscles, tooth grinding or 'bruxism', and fractured teeth are often found.⁶⁻⁷

It is interesting to note that the 'microbial biofilm' or 'dental plaque' and dental calculus are deposited at a high rate on tooth surfaces of addicts which in turn puts them at increased susceptibility to developing periodontal disease.¹² The most important clinical manifestations observed in drug abusers are higher CAL (clinical attachment loss), increased probing or pocket depths (>4mm), gingival enlargement, and, mucosal ulcerations like ANUG (Acute necrotizing Ulcerative gingivitis). ^{8,-9, 13-15} Researchers have also described an association between the use of illicit drugs and periodontal tissue destruction causing alveolar bone loss.

¹⁶⁻¹⁷ All these findings profoundly influence developing chronic periodontitis in its most mild to severe forms. To date, no review has provided a comprehensive summary of the effects of three major drugs on the oral cavity and periodontium collectively - methamphetamine, cannabis, and alcohol. Therefore, this review aims to highlight these effects and focus on how the oral tissues have to bear the brunt of their harmful consequences. Additionally, it emphasizes the critical role of dental professionals in the early identification and timely intervention of signs and symptoms of drug abuse in the oral cavity.

Drug dependence is a chronic disease characterized by physical or psychological dependence or both after excessive and repeated use of controlled substances leading to significant impairment, the absence of which causes withdrawal symptoms. ⁵⁻⁶ Drug addiction is defined as the condition of being dependent on controlled substances (alcohol, cannabis, and other drugs). It also involves the continuous desire to take them irrespective of their harmful consequences and long-term effects on the brain.⁷ Illicit drugs and alcohol have significant addiction and dependence potential. Addicts may be either mono or polydrug users.

The periodontium is a group of four tissues namely the gingiva, periodontal ligament, alveolar bone, and cementum that serve as the structural foundation of teeth. Clinically healthy gingiva refers to the absence of or extremely low clinical indicators such as bleeding on probing. redness. swelling/edema, or exudate.⁸ Conversely, periodontitis is a microbial biofilm-induced, host-mediated inflammatory disease that leads to clinical attachment loss (CAL). This attachment loss can be identified clinically by a circumferential evaluation of the erupted teeth with the aid of a standardized the periodontal instrument called probe using

cementoenamel junction (CEJ) as a landmark. 22 Moreover, it is one of the most common inflammatory diseases encountered in the oral cavity.²³ Although the microbial biofilm (plaque) is required but insufficient to cause disease, the host's inflammatory response to the microbial challenge is the key to periodontal destruction. Dental caries is a prevailing chronic infectious disease of the oral cavity in humans resulting in the breakdown or demineralization of the outer enamel layer of the tooth by acid-producing bacteria.²⁵ Currently, the Etiology of caries is fuelled by the four-factor theory that is based on the interaction between the oral microbiome, oral environment, host, and time. ²⁶ Studies by John Featherstone et al. concluded that oral bacteria, reduced salivary flow, poor nutritional habits, and dietary carbohydrates are significant determinants of caries progression. Streptococcus Mutans and Lactobacilli have been identified as the main causative agents in the pathogenesis of dental caries.

There have been several different types of studies cross-sectional. retrospective, and observational conducted throughout the years that compared the oral health profile of people who indulge in the use of controlled substances to those who do not.²⁷ The oral cavity of such individuals shows a trend of being at a higher risk of caries and periodontal disease.²⁸ The most common findings were advanced caries more commonly referred to as severe tooth decay, and tooth loss all of which may be attributed to the lifestyle patterns followed by drug users.²⁹ This may be directly or indirectly related to the fact that addicts fail to take care of their oral hygiene, have poor nutritional intake, and have salivary dysfunction. 30

Methodology

Inclusion criteria

• The inclusion criteria were as follows:

- Study design: *In-vivo* studies Types of studies included were literature reviews, case studies, observational studies, clinical trials, meta-analyses, and comparative studies.
- Participant characteristics: People who consumed drugs like Cannabis, alcohol, and Methamphetamine aged 18 years and older.
- Articles published in the English language.
- Articles included all and not limited to any specific geographical area
- Articles from 2000-2023 and available as free text including abstracts only.

Exclusion criteria: The exclusion criteria were as follows:

- Non-clinical studies, *in-vitro* studies.
- Studies performed on individuals less than 18 years of age.

Methamphetamine

Table 1: Descriptive characteristic

Search protocol and study selection

A comprehensive electronic search of the database was performed till March 31st, 2023 for the studies published within the last 23 years (from 2000 to 2023) using the following databases: PubMed, Google Scholar, and SCOPUS to retrieve articles in the English language.

Search strategy

Appropriate keywords and Medical Subject Housing Terms (MeSH) were selected and combined with Boolean operators like AND. The search strategy used was as follows: (drug abuse AND periodontal disease), (drug abuse AND effects on oral cavity), (alcohol AND periodontal disease), (alcohol AND oral cavity), (Methamphetamine AND periodontal disease), (drug abuse AND periodontal disease), (drug

Sn.	Author/Year	Place of study	Sample size	The mean age of the participants	Impact on oral health	Outcome assessment	Conclusion
1.	Clague, Jason et.al., 2017 (31)	United States	571	Not mentioned	Caries, untreated decay, missing teeth, bruxism	To assess the effect of meth use on teeth	Sugar consumption and poor oral hygiene override the mode of intake and frequency of meth use in terms of affecting dental health.
2.	Turkyilmaz I. 2010 (32)	United States	1	30	Carious lesions, halitosis, pain	Alert clinicians regarding meth mouth and its serious health risks	Oral manifestations of meth mouth may be identified by dentists which will help them manage and treat these patients better
3.	Spolsky, Vladimir W et al., 2017 (33)	Los Angeles, USA	546	42	Periodontal disease	Determine the presence and severity of periodontal disease in MA users	Frequency of MA use had a minimal impact on periodontal disease as compared to a history of smoking and sugar intake.

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4.	Ravenel, Michele C et al., 2012 (34)	Germany	44	Not mentioned	higher rates of decayed surfaces, missing teeth, tooth wear, plaque, and calculus	Characterize the oral health of subjects with a history of meth abuse as compared to non- abusing control subjects	The quality and nature of saliva play an important role in meth mouth
5.	Ye, Tao, et al., 2018 (35)	Eastern China	162	33	Gingival bleeding, dental calculus, periodontal pocket, and loose teeth	Determine the prevalence and severity of periodontal disease in a convenience sample of MA users.	The status of caries and periodontal diseases among former male drug users in Eastern China was poor. Risk factors are prolonged drug abuse and lower frequency of tooth brushing.
6.	Rommel, Niklas, et al., 2016 (36)	Munich, Germany	100	Not mentioned	Caries, gingival bleeding, periodontal disease, poor oral hygiene	To assess the effects of chronic meth abuse on teeth and oral tissues	Chronic meth use has the potential to destruct oral tissues
7.	Mukherjee, Amrita, et al., 2018 (37)	Los Angeles County, California, USA	545	40.5	Root caries, pain, discomfort while eating	To assess the relationship between meth use and oral health-related quality of life	The oral health status of meth users is worse than that of the general non-meth user population.

Data was evaluated from 7 studies with an aggregate of 1969 patients with a mean age of 36 years. The articles were published between 2000 and 2023 and conducted in 4 countries. 4 studies were conducted in the United States, 2 in Germany, and 1 in Eastern China. The effect of methamphetamine on oral and periodontal health was evaluated in all these 7 studies.

Cannabis

Table 2: Descriptive characteristics

Sn	Author/Year	Place of study	Sample size	The mean age of the participants	Impact on oral health/Oral manifestations	Outcome assessment	Conclusion
1.	Chaffee, Benjamin W., 2021 (38)	United States	18,872	> 18 years	Gingival bleeding, tooth mobility, bone loss, gingivitis	To assess the outcome of cannabis use on periodontal health	Cannabis use is associated with poor oral and periodontal health
2.	Le, A.; Khoo, E.; Palamar, J.J et al., 2022 (39)	United States	14,657	20	Oral lesions - ulcers, sores, wear facets, fractured teeth, caries due to increased sugar intake	To assess the effect of cannabis use on oral health care outcomes	High cannabis use is associated with oral lesions, bruxism, caries, and periodontal disease

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3.	Shariff, J.A., et al., 2017 (40)	United States	1938	> 18 years	Increased probing depths, higher attachment loss	To assess the relationship between Cannabis use and periodontitis prevalence in adults	Recreational cannabis use is associated with higher odds of having periodontal disease
4.	Schulz-Katterbach, M; Imfeld, T; Imfeld, C (2009) (41)	Switzerland	43	18-25	Smooth surface caries, decreased salivary flow, increased intake of sugar	To assess if regular cannabis use causes caries alone or in conjunction with hyposalivation and lifestyle	Cannabis users alone do not have an increased risk of caries, lifestyle, and hyposalivation also play a major role.
5.	Ditmyer, Marcia, et al., 2013 (42)	Nevada, USA	66941	13-18	Increased prevalence and severity of dental caries	To determine trends in Cannabis use and their effect on dental health	Prevalence and severity of dental caries was significantly higher in those who used marijuana than those who did not
6.	Thompson Murray et al., 2018 (43)	New Zealand	903	26	Clinical attachment loss 4mm and greater	To determine if cannabis smoking is a risk factor for periodontal disease	Cannabis is an independent risk factor for periodontal disease

Data was evaluated from 6 studies with an aggregate of 17225 patients with a mean age of 19 years. The articles were published between 2000-2023 and conducted in 3 countries. 4 studies were conducted in the United States,

1 in Switzerland, and 1 in New Zealand. The effect of Cannabis/Marijuana on oral and periodontal health was evaluated in all these 6 studies.

Alcohol

Table 3: Descriptive characteristics

Sn.	Author/Year	Place of study	Sample size	The mean age of the participants	Impact on oral health	Outcome assessment	Conclusion
1.	Priyanka, Kakarla et al., 2017 (8)	India	76	34-35	Decayed, missing, filled teeth, periodontal pockets, oral mucosal lesions - leukoplakia, candidiasis, OSMF, erythroplakia, lower plaque pH	To assess the impact of alcohol dependency on oral health	Alcohol-dependent subjects have higher caries experience, missing teeth, periodontal pockets, oral mucosal lesions, and slightly lower plaque and salivary pH than non-alcohol subjects
2.	Harris, C K et al., 2004 (44)	South London	693	40.5	Leukoplakia, oral carcinoma	To assess the relationship between alcohol and oral mucosal lesions	Alcohol may contribute to oral lesions directly or indirectly
3.	Jansson, Leif., 2008 (45)	Stockholm County, Sweden	513	Not mentioned	Caries, calculus, periapical lesions	To assess the effect of alcohol consumption on dental health	Individuals with high alcohol consumption have more decayed teeth and periapical lesions indicating the involvement of

							lifestyle factors like diet. No effect on periodontal health.
4.	Tezal, M et al., 2001 (46)	New York, USA	1371	49.5	Gingival bleeding, attachment loss	To assess the relationship between alcohol and the severity of periodontal disease	Alcohol may not be a true risk factor for periodontal disease
5.	Rooban T et al., 2009 (47)	Chennai, India	500	34	Smokers melanosis, oral submucous fibrosis, leukoplakia	To assess the prevalence of oral mucosal lesions in alcohol abusers	Alcohol abusers have poor oral hygiene and are at higher risk of oral lesions and periodontal disease

Data was evaluated in 5 studies with an aggregate of 3153 patients with a mean age of 31 years. The articles were published between 2000-2023 and conducted in 4 countries. 2 studies were conducted in India, 1 in the United States, 1 in the United Kingdom, and 1 in Sweden. The effect of alcohol on oral and periodontal health was evaluated in all these 5 studies.

Discussion

Drug abuse or substance abuse is described as the consumption of chemicals to create pleasurable effects on the brain. The target audience ranges from young adults to older individuals. The present studies in this literature review aimed to investigate and summarize the existing evidence of the effect of three major drugs - Methamphetamine, Cannabis/Marijuana, and Alcohol on oral and periodontal health in adults. The findings of these research studies shed light on the detrimental impact of drug abuse on oral health, specifically concerning periodontal health. To the best of our knowledge, this is the only literature review that provides a comprehensive outline of three major drugs under one roof - methamphetamine, cannabis/marijuana, and alcohol.

According to Jason Clague et al., methamphetamine use is linked to a range of oral health issues, including dental caries, missing teeth, and periodontal disease. The authors attributed these problems to various factors, such as the drug's impact on saliva production, oral hygiene practices, and dietary habits. One key mechanism discussed is the drug's ability to reduce salivary flow, leading to xerostomia or dry mouth. This decreased salivary production contributes to an increased incidence of dental caries and periodontal disease, as saliva plays a crucial role in neutralizing acids, remineralizing enamel surfaces, and washing away food particles and bacteria. The authors also highlighted that individuals who abuse methamphetamine tend to neglect oral hygiene, leading to the accumulation of plaque and bacteria. Moreover, stimulant effects cause bruxism or teeth grinding which worsens oral health. ³¹

Furthermore, the authors discuss the association between methamphetamine users' preference for sugary and acidic beverages. These dietary choices coupled with the drug's effect on saliva and oral hygiene create an environment conducive to dental decay and erosion.³¹ Vladimir W. Spolsky et al., established that high frequency of methamphetamine use alone did not impact the severity of periodontal disease however cigarette smoking was a major risk factor. ³³ According to Michele Ravenele et al., similar oral health issues were noted in participants abusing methamphetamine. A higher number of DMFT (decayed, missing, filled) tooth surfaces were present in the oral cavity. ³⁴ The authors also studied salivary analysis which showed reduced pH making tooth surfaces more susceptible to acidic breakdown and erosion as discussed by Jason Clague et

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al. ^{31,34} Studies by Ye Tao et al. also included periodontal indices like pockets depths, calculus, and gingival bleeding which was much higher in meth users.³⁵ A case report by Turkyilmaz described similar findings which included dental pain from rampant carious lesions, halitosis, and compromised esthetics.³² Niklas Rommel et al. reported larger numbers of caries, higher bleeding on probing, and periodontal disease in chronic methamphetamine users.³⁶ Mukherjee Armita et al. discovered that while caries mainly affected root surfaces in meth abusers, they also experienced pain and discomfort while eating. Furthermore, this affected their social well-being in terms of feeling embarrassed while being around friends and the general public. ³⁷

The effect of cannabis on oral and periodontal health is a topic that has gained attention in recent years. While research on this specific area is ongoing, there are several potential effects that cannabis use may have on oral and periodontal health. Studies by Benjamin Chaffee, Shariff, J.A et al., and Thompson Murray et al. reported that cannabis use positively accelerated the progression of periodontal disease.^{38,40,43} Through their research Schulz-Katterbach et al., Ditmyer, Marcia et al., Le, A.; Khoo, E.; and Palamar, J.J et al. all established that cannabis can lead to an increased risk of caries through its potential to affect salivary production leading to xerostomia or dry mouth. Moreover, these individuals frequently crave sugary and acidic foods and beverages which makes them extremely susceptible to developing carious lesions.^{39, 41,42} Additionally, Le, A.; Khoo, E.; Palamar, J. et al have suggested a potential link between cannabis use and oral lesions which may be precancerous. Evidence is still limited and more research is required to establish a definitive connection. ³⁹

Alcohol use may have various effects on oral and periodontal health. While light to moderate alcohol

consumption may not have significant harm, excessive or chronic alcohol use can lead to serious oral health issues. Several studies have investigated the relationship between alcohol consumption and the progression of oral and periodontal diseases. Studies by Priyanka, Kakarla et al., Harris, C K et al., and Rooban T et al. established that alcohol consumers are at an increased risk of oral mucosal lesions like leukoplakia, erythroplakia, oral submucous fibrosis, candidiasis few of which may be pre-cancerous. ^{8,44,47} Evidence suggests that alcohol when combined with tobacco interacts to form a synergistic effect that can amplify the risk of oral cancer many times more than drinking alone.⁴⁸ In the report on Carcinogens, the National Toxicology Program of the US Department of Health and Human Services has established alcohol as a known human carcinogen. Similar to methamphetamine and cannabis, chronic alcohol users experience high caries activity and a greater prevalence of periodontal disease due to the known underlying fact that substance abusers are prone to xerostomia, and ingest high quantities of refined sugars and carbohydrates. 49, 50

On the contrary, studies by Leif Janson did not find significant associations between alcohol and periodontal disease. ⁴⁵ The possible explanation for this may be that this study was conducted in a Swedish population, which may have different characteristics and behaviors as compared to other populations. The study by Tezal, M. et al. concluded that alcohol consumption was not significantly associated with alveolar bone loss or the presence of subgingival micro-organisms which is a measure of periodontal support.⁴⁶ This data highlights that the need for further research is warranted to investigate mechanisms and pathways linking alcohol consumption and periodontal disease.

It is important to understand that the literature reviewed in this paper has a few limitations like relatively small or variable sample size. Therefore, the generalizability of the findings may be limited. The prevalence and severity of findings may be different in different countries and cultures. The mode of administration of cannabis and methamphetamine is not taken into consideration in these studies. So further research and longer-term studies with diverse and larger populations are required to gain a more comprehensive understanding of the oral health implications of drug abuse on oral and periodontal health.

Overall, the findings emphasize the importance of raising awareness among healthcare professionals and the general public about the undesirable consequences of drug abuse. This oral health crisis requires extra attention from clinicians, researchers, policymakers, and educators. By gaining an in-depth understanding of the causes and repercussions of drug-related oral and periodontal diseases, as well as the barriers and facilitators to oral health care for drug users, it is possible to improve oral health and overall health outcomes of this vulnerable population.

Conclusion

In conclusion, this literature review has provided a comprehensive understanding of the effects of drug abuse on oral and periodontal health. The findings indicate that drug abuse, particularly the use of methamphetamine, cannabis. and alcohol, has detrimental effects on oral health resulting in a multitude of oral diseases. These include but are not limited to dental caries, periodontal disease, xerostomia, oral mucosal lesions, and oral cancer. The mechanisms through which these drugs affect the oral cavity are complex and involve a combination of direct and indirect factors including drug pharmacology, route of administration, frequency and duration of use, oral hygiene practices, salivary function, nutritional status, and immune system function.

Drug abuse poses significant challenges to oral health professionals in providing the appropriate treatment and care. The management of oral health problems in drug abusers requires a multidisciplinary approach involving between dental collaboration professionals, psychologists, addiction specialists, behavioral health specialists. and doctors. Timely identification, prevention, and intervention strategies are essential to address the oral health challenges faced by drug abuse.

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