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MESTRADO INTEGRADO EM MEDICINA DENTÁRIA

Trabalho submetido por

Lucie Catherine Yvonne Suzy Maréchal

para a obtenção do grau de Mestre em Medicina Dentária

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THE EFFECT OF THE DRUG DEPENDENCE IN THE ORAL CAVITY

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Trabalho orientado por

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Resumo

Atualmente, o consumo de substâncias ilícitas como a cocaína, crack, ecstasy, heroína entre outros, tem aumentado em todo o mundo. A dependência destas substâncias é vista como uma doença crónica, com fases de libertação e fases de recaída. Nestes comportamentos de dependência há um envolvimento dos ciclos cerebrais, o que levará a mudanças no comportamento que poderão ter impacto na saúde oral. Muitas vezes é complicado para estes doentes abandonarem o vício por causa do *craving*. O *craving* é o desejo de repetir a experiência em função dos efeitos de uma dada substância. Todas as faixas etárias são afetadas por estes comportamentos de adição, havendo uma considerável prevalência entre os jovens. São várias as consequências destes comportamentos na cavidade oral, podendo o seu efeito ser devastador.

O médico dentista tem um papel importante na prevenção deste tipo de comportamentos, assim como na deteção precoce das consequências do uso deste tipo de substâncias. Vários são os tecidos moles e duros a nível oral que são afetados pelo seu uso. Entre eles destacam-se os lábios, dentes, tecidos de suporte periodontal, língua, palato mole e duro. Bruxismo, periodontite, lesões de cárie, úlceras e lesões traumáticas na língua são um conjunto de sinais e sintomas que podem estar associados a este tipo de consumo. Os tratamentos envolvidos vão desde a reabilitação dentária, reabilitação protética ou mesmo intervenções cirúrgicas. Também é importante ter em consideração que por vezes estes pacientes não terminam o tratamento devido a recaídas, estilo de vida ou falta de meios. Além disso, alguns procedimentos dentários podem estar contra-indicados ou condicionados neste tipo de pacientes, sendo importante o clínico conhecer as especificidades da abordagem deste tipo de pacientes.

Para realizar esta revisão narrativa, foi realizada uma pesquisa bibliográfica utilizando-se as plataformas de computadores da literatura científica Pub-Med, SciELO, Medline e Cochrane. A pesquisa foi realizada em português, francês e inglês.

Palavras-chave: Saúde oral, Dependência, Drogas ilícitas, Doença periodontal

Abstract

Nowadays, the consumption of illicit substances such as cocaine, crack, ecstasy, heroin among others, has increased worldwide. Dependence on these substances is seen as a chronic disease, with phases of release and relapse. In these addiction behaviors there is an involvement of the brain cycles, which will lead to changes in behavior that may have an impact on oral health. It is often difficult for these patients to give up addiction because of craving. Craving is the desire to repeat the experience according to the effects of a given substance. All age groups are affected by these addiction behaviors, with a considerable prevalence among young people. There are several consequences of these behaviors in the oral cavity, and their effect can be devastating.

The dentist has an important role in the prevention of this type of behavior, as well as in the early detection of the consequences of the use of this type of substances. Several soft and hard oral tissues are affected by its use. Among them stand out the lips, teeth, periodontal support tissues, tongue, soft and hard palate. Bruxism, periodontitis, caries lesions, ulcers and traumatic lesions on the tongue are a set of signs and symptoms that may be associated with this type of consumption. The treatments involved range from dental rehabilitation, prosthetic rehabilitation or even surgical interventions. It is also important to bear in mind that sometimes these patients do not finish treatment due to relapses, lifestyle or lack of resources. In addition, some dental procedures may be contraindicated or conditioned in this type of patients, and it is important that the clinician knows the specificities of the approach of this type of patients.

To carry out this narrative review, a bibliographical search was carried out using the scientific literature computer platforms Pub-Med, SciELO, Medline and Cochrane. The research was carried out in Portuguese, French and English.

Keywords: Oral health, Addiction, Illicit drugs, Periodontal disease

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LIST OF ACRONYMS

ADHD- Attention-Deficit Hyperactivity Disorder

AIDS- Acquired Immunodeficiency Syndrome

BC- Before Christ

BED- Binge Eating Disorders

BMD- Bone Mineral Density

Ca2+- Calcium

CAL- Clinical Attachment Loss

CB1- Cannabinoid type 1

CBD- Cannabidiol

CIMDL- Cocaine Induced Midline Destructive Lesions

Cl- Chlore

CNS- Central Nervous System

GABA- Gamma-aminobutyric acid

GIC- Glass Ionomer Cement

HIV- Human Immunodeficiency Virus

K+- Potassium

LSD- Lysergic Acid Diethylamide

MDMA- 3-4 methylenedioxymethamphetamine

Mg2+- Magnesium

Na+- Sodium

NCI- National Cancer Institute

NIDA- National Institute on Drug Abuse

pH- Hydrogen potential

PMA- Paramethoxyamphetamine

PWDUD- Patient With Drug Use Disorders

THC- Delta-9-Tetrahydrocannabinol

TMJ- Temporomandibular Joints

UNODC- United Nations Office on Drugs and Crime

WHO- World Health Organization

WWII- World War II

I. INTRODUCTION

In recent decades, illicit substances use has increased significantly around the world (Cury et al., 2018). Illicit substances are defined as drugs for which non-medical use has been prohibited by international drug treaties. Indeed, they entail a significant risk of dependence (Goldstein et al., 2009).

Illicit substances use is associated with social changes, nutritional changes, and oral health changes. This will lead to increase the complexity of medical treatments, particularly in dentistry and periodontal surgery. Cannabis is the most used drug in developed countries and even legalized in some countries such as in the United States of America, Canada, and the Netherlands (Quaranta et al., 2022). However, adverse effects are noticeable on the entire oral cavity (Saini et al., 2013).

In the 1980s, cocaine was used for medical purposes and then its use decreased with the popularization of other illicit substances, such as amphetamines (Goldstein et al., 2009). Amphetamines have been used in many clinical applications (Ciccarone et al., 2011), but the repercussions on health are diverse and important (Quaranta et al., 2022).

Nowadays, the dental world is facing a major challenge due to the augmentation of the consummation of illicit substances. That is the reason why we will put in light some issues.

What are the consequences of illicit substances on the oral cavity? How to rehabilitate functionally and aesthetically this type of patients? What measures should be taken to ensure safe management for the patient and the doctor?

To answer these questions, the most consumed illicit substances in the world will be study which are cannabis, amphetamines, and cocaine.

II. DEVELOPMENT

1. Addiction

1.1. What is addiction?

a. Definition of addiction

Addiction

In 1997, the WHO (World Health Organization) defined addiction as a chronic and relapsing disorder with biological and genetic components, rather than a result of a simple lack of willpower. Addiction is a chronic disease that affects behavior and health, like other neurological and psychiatric disorders (Sdrulla et al., 2015).

Recognition of significant problems is impaired (Quaranta et al., 2022). Dysfunctional emotional responses may be observed, and individuals may be at risk of self-harm, overdose, mental illness, violence, crime, and family disruptions (Goldstein et al., 2009).

Psychoactive substances

According to the WHO, psychoactive substances are substances that, when taken or administered into the body, alter mental processes, perception, consciousness, cognition, or mood and emotions. Many illicit drugs are examples of psychoactive substances, also referred to as psychotropic substances.

Dependence

Dependence is defined as persistent substance use resulting from a physical or psychological craving for the substance (Quaranta et al., 2022).

Tolerance

Substance addiction is often linked to the development of tolerance, which occurs when an individual repeatedly uses a substance, leading to a decrease in its effects. As a result, the individual may need to increase the amount of the substance they consume to achieve the same desired effect, as described by Quaranta et al. (2022).

Craving

Craving is characterized as a loss of control, marked by an irresistible urge to consume despite a lack of desire at the time. Craving is an early indicator of addiction, allowing for the identification of dependent individuals (Gauld et al., 2023). It is craving that drives relapse, which often occurs after withdrawal (Pitchot et al., 2013).

Withdrawal

Withdrawal is defined as the cessation of drug use, characterized by a decrease in motivation and a loss of energy, leading to a decline in one's ability to perform daily activities. This state is often accompanied by a deterioration of personality (Zehra et al., 2018).

Remission and recidivism

This disease is characterized by recurring cycles of remission and relapse. Brain circuits are involved, including those responsible for motivation, reward, and memory processing. Furthermore, complex interactions between these circuits, as well as genetic, environmental, and individual experiential factors, contribute to its pathophysiology (Sdrulla et al., 2015),

b. Prevalence

According to the UNODC (United Nations Office on Drugs and Crime) World Drug Report, in 2017, approximately 250 million people, or 0.6% of the global population between the ages of 15 and 64, had an addiction to an illicit substance, representing one in twenty adults. Moreover, more than 29 million people who use drugs are reported to suffer from substance use disorders, yet only one in six individuals receives treatment for withdrawal.

The prevalence of drug use varies by gender, with men being three times more likely to use cannabis, cocaine, or amphetamines than women. Women, on the other hand, are more likely to use opioids and tranquilizers for recreational purposes. Notably, the prevalence of drug use is higher among youth than among adults. Furthermore, gender disparities are lower among youth populations (Cury et al., 2018).

In 2017, the world rates of drug use were as follows: cannabis use was reported at 77.8%, amphetamines with ecstasy at 33.5%, and cocaine at 29.5% (Cury et al., 2018).

1.2.The processes of addiction

a. Person at risk

These factors do not automatically lead to addiction to illicit substances, but they may increase the risk in some individuals. Conversely, it is also possible to develop an addiction without the presence of any of these risk factors.

Genetic factors also play a crucial role in the development of substance dependence. Individuals with a family history of substance abuse are more likely to develop substance use disorders (Heatherton et al., 2014).

Environment also plays a significant role in the development of dependence. Family dynamics can contribute to the risk of addiction, particularly if parents struggle with substance abuse or have a permissive attitude towards alcohol and drugs. Additionally, traumatic experiences, such as sexual abuse or violence, can also increase the likelihood of developing an addiction (Pickard et al., 2015) (Helton et al., 2014).

Social factors, such as socioeconomic status, race, and gender, can also contribute to the risk of developing an addiction. Individuals from disadvantaged or marginalized social groups may be more likely to experience substance use disorders (Pickard et al., 2015)

Biological factors: such as personality traits, anxiety, and depression, can also contribute to the risk of developing addiction. Individuals with pre-existing mental or physical health issues may be more susceptible to substance use disorders (McFall et al., 2010).

Additional factors: including easy access to substances, social pressures, and stressful life experiences, can also increase the risk of addiction (Heatherton et al., 2014).

b. The stages of addiction

To understand the mechanisms of addiction of illicit substances, there are articles which focused on the stage of addiction.

Intoxication/Binge Stage

This stage starts with the consumption of a rewarding substance (Semaan & Khan., 2023).

Withdrawal/Negative Affect Stage

Withdrawal is a negative feeling. To stop this negative sensation the addict will consume even more substances. The intoxication stage is reinforced (Semaan & Khan., 2023).

Preoccupation/Anticipation Stage

It takes place during abstinence. The duration of anticipation stage depends on the severity of the disease. It can last from several hours to several days. The preoccupation stage is also known as "craving" (Semaan & Khan., 2023).

1.3.Brain and addiction

Addiction is a complex and multifaceted disorder that involves multiple brain regions. The maintenance of addiction is supported by the interplay of these regions, which work together to perpetuate the addictive cycle (Sdrulla et al., 2015).

a. The neuronal circuit

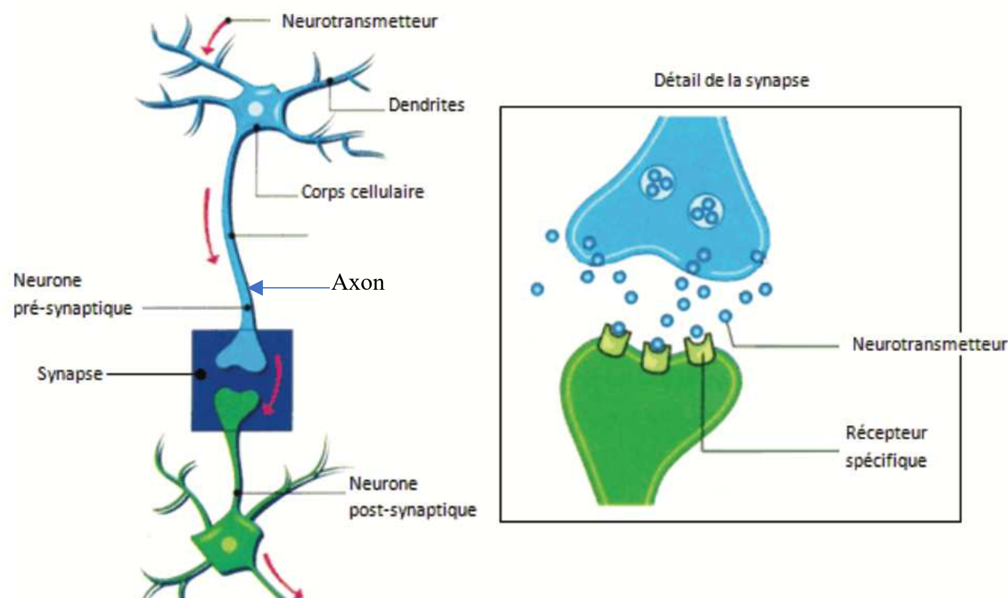

Figure 1 - Transmission of nerve impulses between neurons thought neurotransmitters (Adapted from Dopamine, 2017).

The neuronal circuit is composed by nerve cells. There is a communication to transmit the information in the system, between neurons. It consists of several elements: (Luo, 2021).

- Neurons: nerve cells that receive, process, and transmit electrical signals. Neurons are the basic functional units of the nervous system.

- Axon: the extension of each neuron that transmits electrical signals to other neurons or muscles or glands.

- Dendrites: the extensions of each neuron that receive electrical signals from other neurons.

- Synapses: the narrow spaces between axon endings and dendrites of two adjacent neurons, where electrical signals are exchanged.

There are connected to compose complex networks, to permit the transfer of complex information (Luo, 2021).

b. The neural transmission

In the brain, the communication between neurons is facilitated by neurotransmitters, which are chemical messengers. The use of psychoactive substances triggers the production and release of these neurotransmitters, ultimately influencing their action on the neuronal system (Tomkins & Sellers, 2001).

There are common neurotransmitters involved in the effect of cocaine, amphetamine, and cannabis:

Dopamine: the dopamine neurons play a significant role in the processes of motivation, memory consolidation, and reward processing, and have a functional involvement in the regulation of motor activity.
Only **cocaine and amphetamine** have a direct impact on the dopamine release mechanism in the synaptic cleft, where they interact with the dopamine transporter that captures and reuptakes dopamine, thereby reinternalizing it within the pre-synaptic neuron (Maad-Digital, 2020).
THC (Delta-9-Tetrahydrocannabinol) would indirectly modulate the reward circuit by influencing dopamine release. Specifically, excitatory glutamate neurons exert control over inhibitory GABA neurons that are themselves connected to dopamine neurons. The reduction

in activity of glutamate neurons caused by THC would result in decreased activation of inhibitory GABA neurons, thereby increasing the release of dopamine (Maad-Digital, 2020).

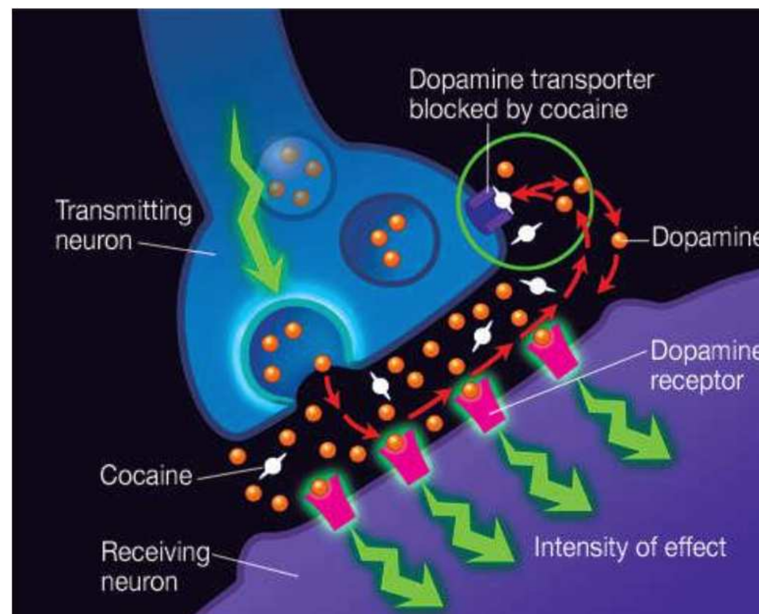

Figure 2 - Mechanism of action of cocaine on dopaminergic synaptic endings (National Institute of Drug Abuse)

Serotonin: plays a crucial role in regulating various physiological and cognitive processes, including the sleep-wake cycle, attention, memory, pain perception, anxiety, and emotional responses. However, serotonin is most notably associated with the modulation of mood, with a decrease in serotonin levels linked to a decrease in mood and an increased risk of depression.

Additionally, altered serotonin levels have been linked to impulsivity and aggressiveness (Maad-Digital, 2020).

THC leads to a decrease of serotonin. The precise mechanism by which this occurs is still unknown.

MDMA (3-4 methylenedioxymethamphetamine) has a dual effect on serotonin reuptake and release.

Firstly, it inhibits the reuptake of serotonin, which prevents excessive clearance from the synaptic cleft. **Secondly**, it can operate in reverse on vesicular and membrane transporters, leading to the release of serotonin from storage vesicles into the synaptic cleft. This results in a significant increase in serotonin concentration.

Cocaine's inhibition of dopamine and serotonin reuptake allows these neurotransmitters to accumulate in excessive amounts in multiple brain structures, altering their normal function (Maad-Digital, 2020)

Glutamate: the most abundant excitatory neurotransmitter in the brain, is responsible for more than 70% of all synaptic transmissions. Dopamine neurons, which play a crucial role in the reward circuit, receive numerous connections from glutamate neurons. When this connection is direct, it actives the release of dopamine, thereby exhibiting excitatory properties (Maad-Digital, 2020).

Cocaine indirectly increases Glutamate receptor expression and glutamatergic transmission, leading to its excitatory effects.

THC exerts an inhibitory effect on glutamatergic transmission by reducing glutamate release at the presynaptic level (Maad-Digital, 2020).

GABA: (Gamma-aminobutyric acid) is a neurotransmitter with inhibitory properties, plays a crucial role in regulating neuronal excitation levels. Its inhibitory effects counteract the excitatory effects of glutamate, thereby maintaining a balance in neural activity.

THC activation of the CB1 (Cannabinoid type 1) receptor by THC will result in a decrease in the release of GABA into the synaptic cleft, thereby altering the normal inhibitory tone of the neural network.

Cocaine does not exhibit an impact on GABA receptors (Maad-Digital, 2020).

2. The illicit substances

2.1.Cocaine

a. History

Cocaine is a naturally occurring substance derived from the Erythroxylum Coca plant, primarily produced in South America, particularly in Peru, Colombia, and Bolivia. Historically, it was used in religious ceremonies, and later for medicinal purposes, with its effects reported to reduce hunger and increase excitement (Hughes, 2016).

In the 19th century, research on cocaine led to the isolation of its alkaloid compound. In 1879, cocaine was first used as a treatment for morphine addiction. In 1884, student Albert

Neiman discovered its anesthetic properties, particularly for epidural and spinal anesthesia. In 1900, cocaine was mixed with wine and sold as a medical drink, as well as being incorporated into Coca Cola. Until 1916, cocaine was available in the United States without a prescription, often sold as tonics, toothache remedies, or patented medicines. In the 20th century, the addictive nature of cocaine became well understood. The Harrison Narcotic Act allowed for the taxation of cocaine except for medical use. By 1930, cocaine use decreased with the emergence of other illicit substances, such as amphetamines (Goldstein et al., 2009).

b. What is cocaine?

Cocaine is a potent psychostimulant that affects the central nervous system, known for its highly addictive nature. Its rapid absorption into the bloodstream leads to a short plasma half-life of 45 to 90 minutes. The use of cocaine is often associated with a range of physical and mental health problems.

There are two main forms of cocaine: cocaine hydrochloride, which can be consumed intranasally or intravenously, and a mixture of cocaine with ammonia or baking soda, commonly referred to as "crack," which is typically inhaled (Pitchot et al., 2013).
Notably, cocaine is often used in combination with alcohol, which can amplify its effects and lead to a substance known as coca ethylene (Goldstein et al., 2009).

Cocaine use leads to:
- a sensation of full power
- improved self-esteem
- pleasure
- disinhibition
- sensory awakening
- loss of appetite
- intellectual awakening (Tomkins & Sellers, 2001).

c. Impact on health

Cocaine abuse is a significant and escalating concern in Europe (Nitro et al., 2022). It has many harmful effects, including serious and potential long-term physical, mental and psychological consequences (Cury et al., 2018).

The effect of the drug dependence on the oral cavity

Physical effects:
- nausea and vomiting
- diarrhea or constipation
- fever
- tremors
- abnormal facial expression
- increased blood pressure
- tachycardia
- dehydration (Pitchot et al., 2013).

Mental effects:
- paranoia
- auditory or visual hallucinations
- depression
- emotional instability
- personality changes
- anxiety
- sleep disorder (Pitchot et al., 2013).

Psychological effects:
- physical and mental dependence
- problems with memory and attention
- loss of self-confidence
- social relations problems (Cury et al., 2018).

Long-term effects:
- brain degeneration
- attentive hyperactivity deficit
- bipolar disorder
- severe and persistent depression (Pitchot et al., 2013).

Serious and potential effects:
- heart or cardiovascular attack

- degeneration of the heart valves
- pulmonary tuberculosis (Pitchot et al., 2013)

2.2. Amphetamines

a. History

Amphetamines are a class of aromatic compounds derived from phenylethylamines. The Japanese chemist Nagayoshi Nagai isolated the active ingredient of the medicinal herb, Ephedra, around 1885. Ephedrine, an alkaloid derived from the plant Ephedra vulgaris, is the precursor to psychostimulant drugs, including amphetamines (Morelli & Tognotti, 2021). In 1887, Romanian chemist Lazar Edeleano synthesized the base of amphetamine (Rasmussen, 2015). Gordon Alles, a Californian chemist, synthesized amphetamine in 1927 and marketed it as Benzedrine®, initially prescribed as a bronchodilator. Amphetamine was later discovered to have pharmacological effects such as improved attention, cognition, and mood enhancement, as well as appetite reduction.

By 1940, amphetamines were used as antidepressants and slimming agents (Rasmussen, 2015). During World War II, Pervitin, a German amphetamine developed by Dr. Fritz Hauschild, was widely used in Nazi Germany to combat insomnia and hunger. Meanwhile, the Americans used Benzedrine during the same period (Morelli & Tognotti, 2021).

In the 1970s, the non-medical use of drugs led to international control measures (Rasmussen, 2015). Today, the primary use of amphetamines is in the treatment of ADHD (Attention-Deficit Hyperactivity Disorder), narcolepsy, and severe obesity as an appetite suppressant for BED (Binge Eating Disorders) (Morelli & Tognotti, 2021).

b. What are amphetamines?

Amphetamines are a highly addictive class of substances that exert a potent psychostimulant effect on the central nervous system (Teoh et al., 2019).

The amphetamine family includes all substances with a substituted phenylethylamine structure. Their action is less intense and slower than that of cocaine, but their effects are more prolonged, with a plasma half-life ranging from 6 to 15 hours. Amphetamines come in various forms, including white powder, tablets, capsules, and liquid (Pinto et al., 2008).

Methamphetamine

Methamphetamine, a member of the amphetamine family, is also known as "crystal," "speed," or "ice." With its prolonged duration of action, it is the most widely consumed form of amphetamine (Prakash et al., 2017). MDMA, another member of the amphetamine family, is primarily composed of the substance and is often referred to as "ecstasy" (Prakash et al., 2017).

MDMA

MDMA, a synthetic substance, exhibits low hallucinogenic properties (Costa & Gołembiowska, 2022). It is widely used globally, particularly among young people, during rave parties (Robledo, 2010). MDMA has a plasma half-life of approximately 6-7 hours. It is typically consumed in the form of crystals or powder, often ingested after being swallowed or mixed with a drink. Alternatively, it may be snorted, smoked, or injected (Costa & Gołembiowska, 2022).

Ecstasy

Ecstasy is a pill that contains MDMA, the primary active ingredient, which is often mixed with other substances such as caffeine, LSD (Lysergic Acid Diethylamide), ketamine, and ephedrine. Additionally, pills may contain other extremely toxic substances like PMA, which can be fatal even at very low concentrations. The tablets are distinguishable by their different colors and logos. Users can consume them orally or crush them to be taken nasally (Costa & Gołembiowska, 2022) (Trkulja & Lacković, 1997).

The effects of MDMA use are:

- intense euphoria
- hyperactivity
- increased alertness
- suppression of appetite and sleep
- increase in empathy
- conviviality
- open-mindedness
- a disinhibition
- well-being

- an increase in physical and mental energy (Pinto et al., 2008).

c. Impact on health

Physical effects:
- diarrhea or constipation
- nausea or vomiting
- muscle cramps
- muscle weakness
- dystonia
- tachycardia
- respiratory difficulties (Pinto et al., 2008).

Mental effects:
- paranoia
- hallucinations
- anxiety
- irritability
- violence
- suicide
- aggressivity (Pinto et al., 2008).

Psychological effects:
- nervous and emotional exhaustion
- trouble with sleep and dreams
- chronic fatigue
- loss of feeling of general well-being
- social isolation (Daldegan-Bueno et al., 2021).

Long term effects:
- gastrointestinal ulcers
- osteoporosis
- bone shift
- schizophrenia (Daldegan-Bueno et al., 2021).

Serious and potential effects:
- rupture of aneurysms or arteries
- pulmonary exhaustion
- heart failure
- heart attacks (Daldegan-Bueno et al., 2021).

2.3.Cannabis

a. History

The origins of cannabis date back to 2800 BC (Before Christ) in China, where it was used for its therapeutic properties. Throughout history, various cultures have utilized cannabis for its
medicinal benefits. In 1753, the first classification of cannabis was established, with two species: cannabis sativa and cannabis indica. In 1843, Irish physicist W.B. O'Shaughnessy reintroduced cannabis to the Western world.

Today, North America, Australia, New Zealand, and West Africa are the largest consumers of cannabis. Interestingly, the plant is grown globally, making it accessible to a wide range of people. Internationally, cannabis has been regulated since the Second Opium Conference and the 1925 International Opium Convention. The medical use of cannabis is a topic of ongoing debate, both among patients and within the medical community.

In the 21st century, cannabis is used to treat a range of conditions, including chronic pain, cancer, seizure disorders, nausea, anorexia, and infectious diseases. In Canada, medical use of cannabis has been authorized since 2001, as well as in certain European countries such as Germany, Italy, and the United Kingdom. In the United States, 38 states have legalized cannabis use for medical purposes since 2003.

While some countries have legalized pharmaceutical products based on synthetic cannabinoids, such as CBD, cannabis has also been legalized for recreational purposes in nations like the Netherlands, New Zealand, and Australia (Johnson & Colby, 2023),

b. What is cannabis?

Cannabis, a psychoactive substance, and flowering plant is the most consumed illicit substance worldwide. Derived from the plant Cannabis sativa, it contains 60 cannabinoids,

including THC. THC is the most abundant cannabinoid and the primary psychoactive compound. Marijuana, hashish, and hash oil are the three main forms of cannabis. Marijuana consists of dried leaves and flowers, while hashish is the resin form and hash oil is hashish purified with a solvent.

When inhaled, 20 to 70% of THC reaches the brain and lungs, with peak concentration achieved within 10 minutes. In contrast, oral ingestion of THC leads to its maximum effect between 0.5 and 2 hours, with intestinal absorption resulting in a longer duration of action (ElSohly et al., 2017).

Positive properties are:
- anxiolytic effect
- sedation
- analgesia
- stimulation of appetite
- euphoria
- vigilance
- happiness
- creativity
- social benefit
- improved sleep (Cohen and al., 2019).

c. Impact on health

Physical effects:
- hyperemia
- increased appetite
- increased blood pressure
- tachycardia
- bronchodilator effect
- coordination problems (Hall & Degenhardt, 2013).

Mental effects:
- depression
- anxiety

- psychosis
- suicidal tendencies
- paranoia (Hall & Degenhardt, 2013).

Long term effects:
- neurocognitive problems
- cardiovascular and respiratory diseases
- executive function problems
- renal diseases
- digestive problems (Hall & Degenhardt, 2013).

3. Oral cavity

The oral cavity is localized at the entry of the digestive system. The different functions of the oral cavity are speaking, ingestion, chewing or propulsion of foods in the oropharynx (Madani et al., 2014).

The lips surround the oral cavity. There are two distinct parts: the vestibule and the oral cavity proper. The vestibule of the cavity is between the oral cavity proper, the cheeks, teeth, and lips (Madani et al., 2014).

The oral cavity proper contains the tongue. Anteriorly and on the sides, there are the teeth supported by the alveolar processes. Posteriorly, the isthmus of the fauces delimited the oral cavity.

The roof of the oral cavity is composed posteriorly by the soft palate and anteriorly by the hard palate (Madani et al., 2014).
The oral cavity is composed of hard and soft tissues (Madani et al., 2014).

3.1.Hard tissues

a. Teeth

Usually, an adult has 32 permanent teeth which appear from 6 years. Normally, in children, there are 20 decidual central incisor, lateral incisor, canine, molar. There is no premolar or third molar in the first dentition (Madani et al., 2014).
All teeth have two parts: the upper part is the crown and the lower part, the root, or the roots. The upper part of the crown is covered by enamel which is the hardest substance in the human body. Dentin under enamel may have sensitivity if enamel above is lost (Madani et al., 2014).

The pulp is the inner part of the tooth. It is a soft tissue containing nerves and blood vessels, localized under the dentin. The cement covers the roots and helps to attach tooth to the bone (Madani et al., 2014).

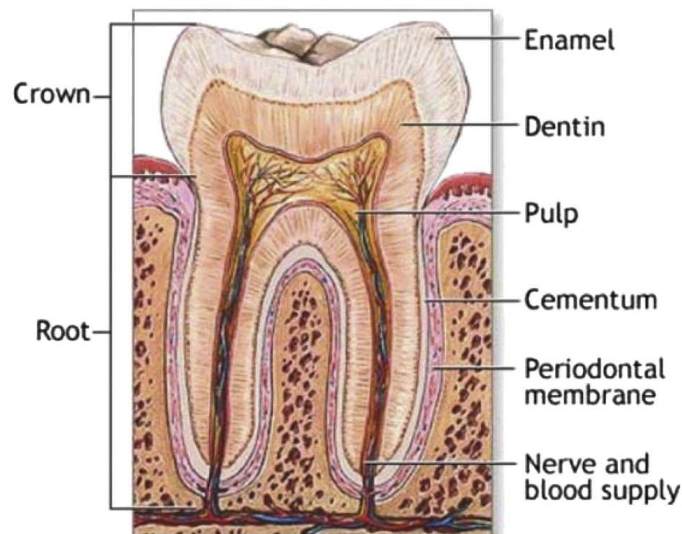

Figure 3 - Anatomy of a tooth (License obtained for its use by the author - Yasny & Herlich, 2012).

b. Hard palate

The hard palate is located on the roof of the oral cavity, anterior to the soft palate. It is formed by bones, which are fused. It separates the oral cavity from the nasal cavities. The hard palate allows important functions: speech, eating and oral sensation (Madani et al., 2014).

c. Bone structures and Temporomandibular Joints (TPJ)

Bone structures

The effect of the drug dependence on the oral cavity

The maxillary and mandibular bones are two essential bones of the oral cavity that play a crucial role in the formation of the structure of the mouth and face.
The upper bone is the maxilla, and the lower bone of the oral cavity is the mandibula. The mandibular bone is the only moving bone of the face (Madani et al., 2014).

TPJ

The joint between the mandibular bone and the maxilla is the TPJ, also called the jaw joint. It is a synovial joint. The two bones are connected by a joint capsule containing synovial fluid that allows the movements of the jaw (Madani et al., 2014).

3.2.Soft tissues

a. Tongue and lips

Tongue

The tongue is a muscular organ which occupies most of the oral cavity and the oropharynx. It is located at the floor of the mouth and is composed of muscle tissue, connective tissue, and epithelial tissue. It is divided into three parts: the base, the body, and the tip.

The tongue is essential for the swallowing of food and liquids, as well as for the formation of sounds during speech. It is also involved in the sense of taste through to the taste buds located on its surface (Madani et al., 2014).

Lips

The lips are musculo fibrous structures that are located outside the oral cavity. They are composed of two parts: the upper lip and the lower lip. The lips are composed of 4 tissue layers: cutaneous, muscular, glandular and mucosa (Madani et al., 2014).
The lips are used for phonation, facial expressions, chewing and sensations. Vermilion border separates the skin from the mucosa of the oral cavity. The corner of the lips is the meeting between the upper lip and the lower lip (Madani et al., 2014).

b. Salivary glands

The salivary glands are a trio of organs located in the mouth that synthesize saliva, a vital liquid that plays a crucial role in the digestive process. The three main pairs of salivary glands are the parotid glands, submandibular glands, and sublingual glands (Famuyide et al., 2022).

The parotid gland: is the largest of the salivary glands and is located on either side of the face, below and in front of the ear. It produces about 25% of the total saliva production.

The submandibular gland: is the second largest gland, located under the lower jaw, near the mandible. Submandibular gland produces about 60-70% of total saliva.

The sublingual gland: is located on the floor of the mouth, below the tongue. It is composed of small glandular lobules that secrete saliva into the oral cavity through many small channels. It produces about 5% of the total saliva produced by the body (Madani et al., 2014).

Minor salivary glands are small salivary glands located in the oral mucosa (Famuyide et al., 2022).

c. Soft palate

The soft palate is the continuation of the hard palate, extending into the oropharynx. It constitutes the posterior part of the palate and serves as a barrier between the oral cavity and the nasal cavities. Without bony support, it is a muscular projection that terminates at the uvula. The soft palate plays a crucial role in phonation, swallowing, and taste (Madani et al., 2014).

d. Periodontium

The teeth are supported by a complex network of structures. All these structures composed the periodontium, including:
- the periodontal ligament: is composed of thousands of fibers, anchors the cementum to the alveolar bone, while also serving as shock absorbers for the teeth, which are subjected to significant forces during function. It has also a crucial role in sensory perception, nutrient supply, and bone remodeling surrounding the roots.
- gingival tissue: covers the teeth and bone, providing a protective barrier.

- bone: the alveolar portions of the maxillary and mandibular bones contain sockets that support the roots of the teeth.
- blood vessels, and nerves: each tooth and periodontal ligament has a nerve supply, making teeth sensitive to a wide range of stimuli. A sufficient blood supply is essential for maintaining the vitality of the tooth (Madani et al., 2014).

4. The effects of illicit substances on the oral cavity

Nowadays dental practice is complicated by behaviors related to the consumption of illicit substances such as cocaine, amphetamines, or cannabis (Quaranta et al., 2022).

Substances consummation leads to:
- poor oral hygiene habits
- increased sugar consumption
- malnutrition
- few visits to the dentist (Sordi et al., 2017)

Moreover, PWDUD (Patient With Drug Use Disorders) have high levels of:
- plaque
- tartar deposits
- gingival inflammation (Saini et al., 2013).

These situations are the result of neglected of oral hygiene, xerostomia, and altered microbe profiles (Saini et al., 2013), which lead to several oral problems, such as tooth decay and periodontal disease (Teoh et al., 2019).

4.1.Modification of salivary flow rate

a. The role of the saliva

Salivary glands which are in the oral cavity, produce saliva. This liquid contributes to the food digestion. In fact, saliva helps for swallowing and to ease digestion.
It is composed of:
- **Water:** saliva is primarily composed of water, 99%

- Electrolytes: Na^{+} (sodium), K^{+} (potassium), Ca^{2+} (calcium), Mg^{2+} (magnesium), Cl^{-} (chlorine)

- Proteins: enzymes, immunoglobulins, histatins

- Mucins: glycoproteins that help to maintain the integrity of the mucous membrane lining the mouth

- Growth factors: such as epidermal growth factor (EGF), which help to promote wound healing and tissue repair

- Antibodies: immunoglobulins A, G, and M, which help to neutralize pathogens and prevent infections (Chibly et al., 2022)

Saliva also plays a significant role in oral hygiene:

- it helps keep the mouth clean by removing food particles
- neutralizing acids produced by bacteria buffering pH
- to keep oral homeostasis
- providing antibacterial and antiviral properties
- promoting the remineralization of tooth enamel
- and limiting the growth of bacteria responsible for the formation of dental plaque
- prevent dry mouth, which can be a risk factor for cavities and other dental problems (Llena, 2006).

b. What is xerostomia?

Xerostomia can impact oral health and quality of life. It is a sensation of dry month which is uncomfortable. It can be caused by the total or partial loss of saliva. Nevertheless, sometimes, it does not involve loss of saliva. In this case, it is a feeling known as “subjective xerostomia" or "psychogenic xerostomia”. This feeling occurs, although saliva production is normal.

This can be caused by factors such as:

- stress and anxiety
- emotional tensions
- excessive consumption of caffeine or alcohol
- malnutrition or deficiency of certain essential substances

- unhealthy lifestyle habits (Tanasiewicz, Hildebrandt, & Obersztyn, 2016).

The hypofunction (acute or chronic) of the salivary glands is the mainly cause of the xerostomia. The hypofunction can be caused by:
- local diseases of the salivary glands
- infections
- cancer
- obstructive diseases of the salivary ducts
- medications with xerostomia effects
- head and neck radiation
- chronic disorders like Sjögren's syndrome
- the consumption of illicit substances (Dreyer et al., 2021).

Xerostomia and illicit substances

Illicit substances often lead to a sensation of dry mouth, xerostomia. Moreover, for PWDUD there is an increased stress, anxiety and use of tobacco or other chemical products. These lead to xerostomia (Rossow, 2021).

Cannabis

In fact, the study of Teoh et al., 2019 shows that 69.2% of cannabis users have a xerostomia sensation. This occurs almost a few minutes after smoking and can last for hours This is the most important effect in the oral cavity (Teoh et al., 2019).

Amphetamines

The study of Lowenstein, 2009, shows that 95% of amphetamines addicts complain of dry mouth and feel “like they chewed something” (Lowenstein, 2009).

Cocaine

A study of Antoniazzi et al., 2017, shows that 65% of cocaine addicts complained about xerostomia compared to 37.5% non-users.

In addition, hypnotics such as diazepam and zolpidem are used for the transition from the euphoric effect of cocaine. It is known that this kind of medication also have xerostomia effect (Teoh et al., 2019).

Also, cocaine is a substance with a direct action on the salivary gland production. In fact, there is a reduction of saliva, it is the hyposalivation (Antoniazzi et al., 2017).

c. Hyposalivation

The normal quantity of saliva secretion is between 0.25 to 0.35 mL/min, but can increase with
external stimulation such as chewing paraffin blocks to 1.0–3.0 mL/min (Tanasiewicz, Hildebrandt, & Obersztyn, 2016).

Stimulated salivary flow:
- Normal: > 1 ml/min,
- Low: 0.7–1.0 ml/min
- Very low: < 0.7 ml/min (Antoniazzi et al., 2017).

Hyposalivation and illicit substances

There are illicit substances that cause hyposalivation.

Cannabis

Some studies explains that it can cause hyposalivation. Nevertheless, it is still controversial and need more research to show a strong link between cannabis and hyposalivation.

Amphetamines

The study of Teoh et al., (2019), explains a direct action of amphetamine on the production of saliva. Indeed, amphetamine causes a reduction in salivary flow with a reduction of the buffering ability.

Cocaine

For cocaine users there is a significant reduction in stimulated salivary flow, and so a larger occurrence of hyposalivation (Antoniazzi et al., 2017).

The effect of the drug dependence on the oral cavity

The study of Antoniazzi et al., (2017), shows that there is an important reduction in stimulated salivary flow in comparison to non-users, that is 1.02 vs. 1.59 ml/min, respectively.
It has been reported that the stimulated salivary flow for **42.5%** of users is **very low** and for **15%** is **low.**

The production of saliva is directly induced by:
- Impact on nervous systems: including the parasympathetic system, which plays an important role in regulating saliva secretion (Aps & Martens., 2005).
- Influence on hormones: effect of the levels of hormones which play an important role in regulating saliva secretion (Aps & Martens., 2005).
- Reduced blood flow: reduction of blood flow to the salivary glands, which can lead to reduced saliva production (Aps & Martens., 2005).

Hyposalivation leads to functional alterations in chewing, flavor, swallowing and speaking.
It increases the susceptibility to the occurrence of oral issues:
- xerostomia
- caries
- spontaneous bleeding
- gingivitis
- periodontitis
- halitosis
- ulcers
- dental plaque formation
- oral and oropharyngeal infections such as candidiasis
- unilateral or bilateral hypertrophy of the parotid glands
- chelitis (Gil-Montoya et al., 2016).

4.2.The effects of substances on periodontium

The periodontium is constituted of the tissues supporting the teeth: cementum, periodontal ligament, alveolar bone and gingiva (Quaranta et al., 2022).

PWDUD have higher prevalence of oral illness, especially, for periodontal diseases which can be due to the action of illicit substances and the traumatic effect, which depends to the way of consumption (Rossow, 2021). However, the other main causes of oral diseases and their progression are:

- poor oral hygiene,
- frequent sugar intake
- inadequate diet
- infrequent visits to the dentist - can be attributed mainly to an irregular lifestyle
- poor economy
- mental health problems that often accompany illicit drug use (Rossow, 2021).

a. Gingivitis

Gingivitis is a disease characterized by gingival inflammation. It can be induced solely by the bacterial plaque or also associated with other factors. When it is induced solely by the bacterial plaque it is frequently due to poor oral hygiene (Ubertalli, 2022).

Most gingivitis is induced by plaque alone. Moreover, it can be triggered or aggravated by hormonal changes, systemic disorders, medications, or nutritional deficiencies (Ubertalli, 2022).

The other type of gingival diseases is rarer, and it can be caused by bacterial, viral, and fungal infections, allergic reactions, trauma, mucocutaneous disorders and hereditary disorders (Ubertalli, 2022).

The symptoms are:

- redness or inflammation of the gums
- pain or burning in the gums.
- blood or pus when passing the tongue on the teeth.
- tooth sensitivity.
- pain during chewing (Murakami et al., 2018).

Cannabis

The effect of the drug dependence on the oral cavity

For cannabis addicts, there are a lot of alterations in host response, that can explain the severity of periodontal diseases in chronic use caused by the THC which has an immune depressive effect (Lowenstein, 2009).

Moreover, studies show that cannabis smokers have more neglected oral hygiene than non-smokers. This lack of hygiene is also a factor of gingivitis (Teoh et al., 2019).

In this type of patient, a severe inflammatory process sometimes occurs in the gums, with pain, ulceration and sometimes the gums become covered in white areas (Lowenstein, 2009).

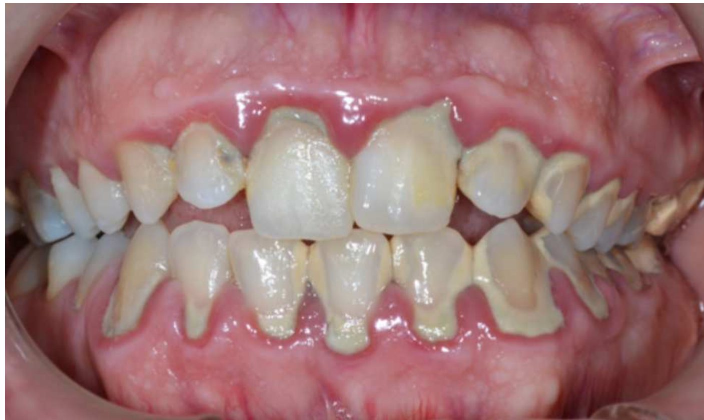

Figure 4 - Clinical presentation of a 20-year-old Caucasian male patient with plaque-induced gingivitis and cannabis-induced gingival enlargement (License obtained for its use by the author - Quaranta et al., 2022).

Amphetamines

Necrotizing gingivitis accompanied by bone exposure is observable after topical application of ecstasy on the gum (Hughes & Bartold., 2000).

Cocaine

Cocaine addicts are more prone to periodontal problems such as ulcer-necrotic gingivitis localized where the substance is applied. In some case, spontaneous gingival bleeding is observed, and it occurs because cocaine, like many other substances, can cause thrombocytopenia (Lowenstein, 2009).

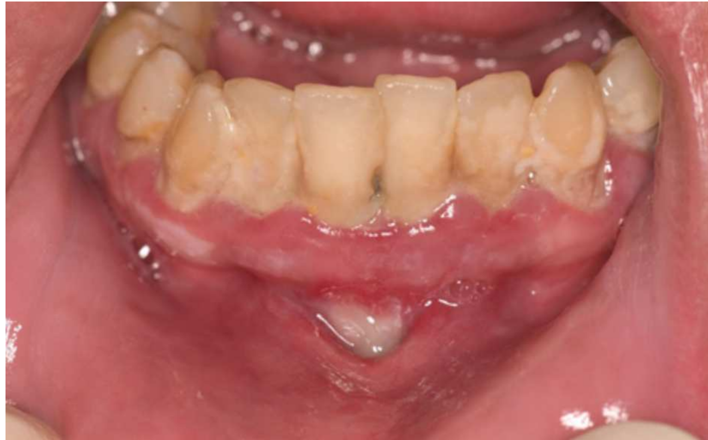

Figure 5 - Chemical traumatic lesion localized at the level of the mucogingival junction in a crack user (License obtained for its use by the author - Quaranta et al., 2022).

Thrombocytopenia is due to inferior number of platelet to the average, less than 150,000/µL. In these situations, there is a higher risk of bleeding (Greenberg & Kaled, 2013). Moreover, without treatment, gingivitis can progress to periodontitis (Ubertalli, 2022).

b. Periodontitis

According to Rossow's (2021) definition, periodontal disease is a chronic inflammatory condition that affects the supporting structures of teeth. This inflammation is caused by bacteria accumulating in gingival pockets, which can lead to tooth loss if left untreated. Factors that contribute to the development of periodontal disease include inadequate oral hygiene, which allows for the buildup of subgingival plaque, as well as other factors such as tobacco smoking, decreased salivary flow induced by drug use, and stress.

For the diagnosis, a clinical examination is done with periodontal survey, and x-ray examination. The existence of periodontitis is established with the presence of periodontal pockets which are greater than 4 millimeters. Most of the time, x-ray shows a loss of alveolar bone (Sanz et al., 2020).

The symptoms are:
- an abundant plaque
- gum redness
- gum swelling
- inflammatory exudate

- the gums are usually painful
- spontaneous bleeding
- fetidity of breath
- teeth become mobile
- chewing becomes painful
- gum recession (Ubertalli, 2022).

Cannabis

In cannabis users, attachment loss and probing depth are the main periodontal signs. Gingival enlargements can also be present. There is a bad effect on periodontal tissues caused by the combustion instead of the cannabis. Moreover, the principal active component, can have an impact on the inflammation (Quaranta et al., 2022).

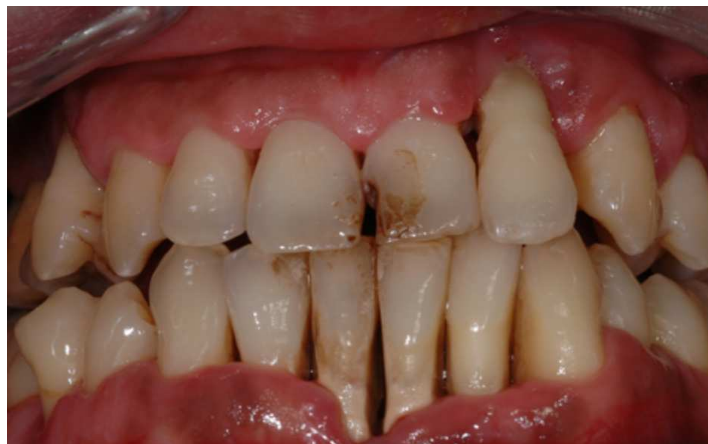

Figure 6 - Clinical presentation of a 25-year-old Caucasian male patient (cannabis user) with generalized Stage IV, Grade C periodontitis (License obtained for its use by the author - Quaranta et al. 2022).

Amphetamines

There is an increased risk of gingival enlargement and periodontitis for patients taking amphetamines.

The study on animal done by Breivik et al (2014), demonstrated that the MDMA can raise the susceptibility to periodontal disease in terms of enhanced bone loss and periodontal fiber loss. This situation is a consequence of the alteration of the immune response due to the disruption of brain immune-regulatory systems caused by the substance (Quaranta et al., 2022)

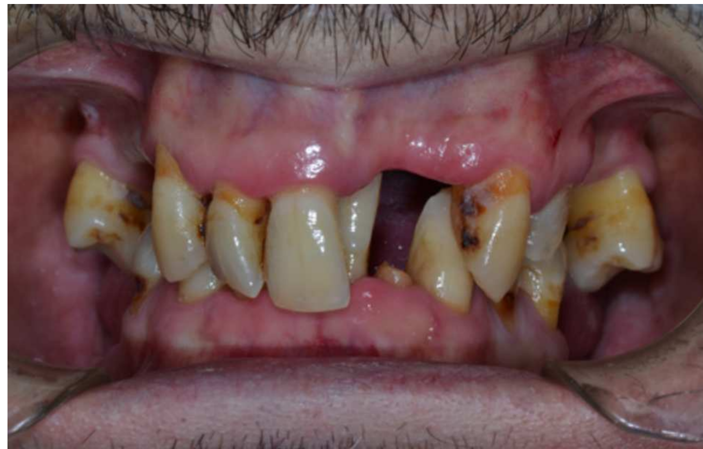

Figure 7 - Clinical presentation of a patient (MDMA user) with generalized gingival recessions and abrasions. MDMA, 3,4-Methylenedioxy-Methamphetamine (License obtained for its use by the author Quaranta et al., 2022).

Cocaine

The link between cocaine use and periodontitis can be attributed to both systemic and local factors (Lowenstein, 2009).

Systemic factors

The most plausible explanation appears to be the **systemic** biological mechanism, which is influenced by the effect of exposure. **In this type of patient, the production of Cytokines and growth factors** by cells can be altered. This situation may have an influence on inflamed periodontal tissue by modulating the differentiation and function of osteoclasts, thus establishing a link between inflammation and the process of bone destruction (Quaranta et al., 2022).

Local factors:

Gingival irritation: using cocaine can cause gingival irritation, causing inflammation and periodontal infection (Fitzpatrick et al., 2019).

Vasoconstriction: cocaine is a vasoconstrictor, which means it causes blood vessels to shrink. This can hinder blood flow to the gums, which can compromise their health and promote the development of periodontitis (Aps & Martens., 2005).

Decreased saliva: cocaine can reduce the production of saliva in the mouth, which can promote the growth of bacteria and lead to inflammation of the gingiva (Antoniazzi et al., 2017),

c. **Ulcerations and other inflammations**

Ulceration is a very common lesion of the oral mucosal which is generally very painful. The mucosal biopsy is advocated if the lesion persists. There are many causes like traumatic cause and the action of the illicit substance directly on the mucosa (Lewis & Lamey, 2023).

Inflammatory gingival hyperplasia is a condition characterized by excessive growth of the gums, caused by abnormal cellular proliferation, accompanied by redness, bleeding, and discomfort. This condition can lead to pain, excessive dental plaque accumulation, and halitosis (Hughes & Bartold, 2000).

Stomatitis is an inflammatory condition characterized by oral mucosa pain and irritation caused by both allergic and irritant substances. This condition is characterized by symptoms of redness, pain, and severe lesions in the mouth (LeSueur & Yiannias, 2003).

Cannabis

Additionally, chronic cannabis use has been linked to other symptoms, including:

- Generalized gingival hyperplasia, which has been reported in some cases. Furthermore, alveolar bone loss can also be associated with these manifestations.

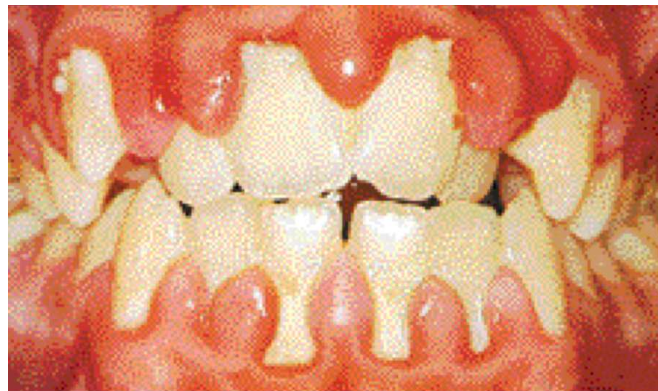

Figure 8 - Gingival hyperplasia in relation to cannabis (License obtained for its use by the author - Hubert-Grossin et al., 2003).

- Cannabis stomatitis has also been described, characterized by micro- and macro-changes in the epithelium and presenting with various signs such as irritation, superficial anesthesia, and salivary stasis (Lowenstein, 2009).

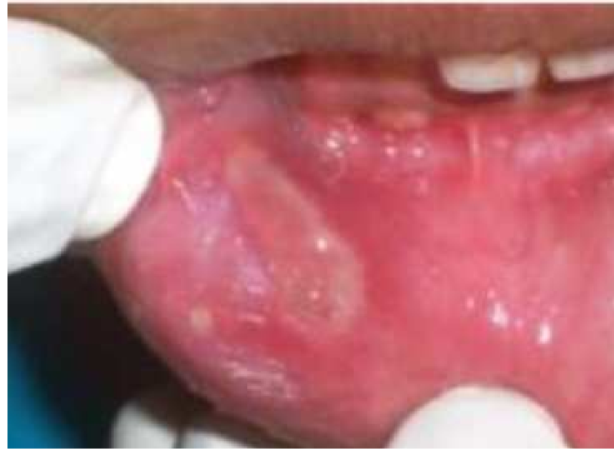

Figure 9 - Stomatitis (License obtained for its use by the author - Shastri & Srivastava, 2015).

Cocaine

Cocaine, through its vasoconstrictive properties, can cause soft tissue damage to the gums and mucosa (Fitzpatrick et al., 2019). In fact, the most common injury associated with cocaine use is the traumatic ulcer, which often occurs when users habitually rub cocaine residue against their gums. It can lead to deep narrow recessions and bone dehiscence (Cury et al., 2018).

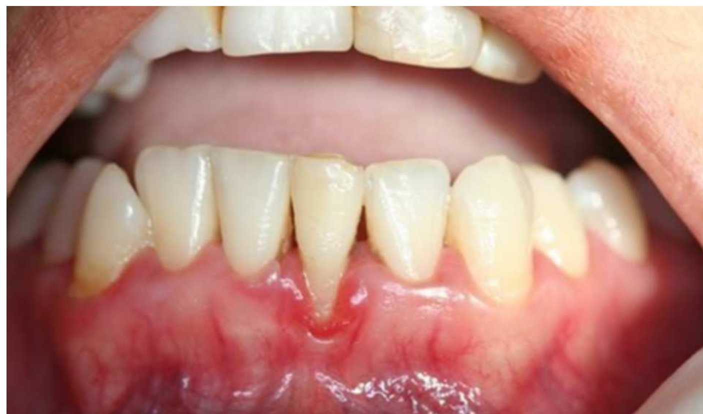

Figure 10 - Clinical presentation of a patient with deep narrow recession and bone dehiscence on the lower left central incisor induced by cocaine use (License obtained for its use by the author - Quaranta et al. 2022).

This appears to induce a strong sensation, similar to inhalation, likely due to the proximity of the mucous membranes and their rich vascularization. These lesions can also manifest as significant recessions, featuring the appearance of bone sequestrums (Lowenstein, 2009).

The effect of the drug dependence on the oral cavity

Cocaine use has also been linked to changes in the oral mucosal tissues, characterized by an increased rate of cellular proliferation in normal buccal mucosal cells, as well as chromosomal breakage and cellular death in oral mucosa cells (Teoh et al., 2019)."

Amphetamines

In an interview with 466 regular ecstasy users, 2.3% reported developing oral ulcers within 24 hours, while 8.2% reported them within 24-48 hours. These ulcers can appear as small openings in the mucous membrane of the attached gingiva. A case study in the literature has described a condition referred to as "necrotizing gingivitis related to ecstasy use" (Quaranta et al., 2022).

4.3.The effects of substances on soft tissues

a. Uvulitis and glossitis

Uvulitis

Uvulitis is a rare oral disorder that can result in significant morbidity and potentially even death. Upon physical examination, the uvula may be observed to be three to four times its normal size, appearing red and swollen. Additionally, severe sore throat and difficulty swallowing secretions are common symptoms associated with uvulitis (Guarisco et al., 1988).

Cannabis

The main etiologies of uvulitis are bacterial and traumatic causes, with excessive cannabis use also being included as a cause (Guarisco et al., 1988).

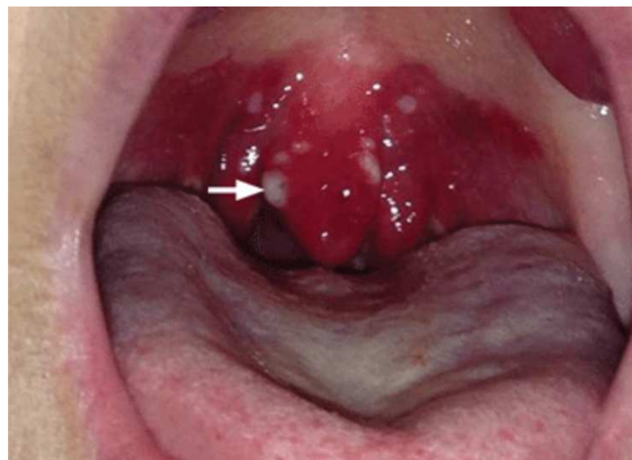

Figure 11 - Uvulitis with exudate (License obtained for its use by the author - Shomali & Holman, 2016).

Diffuse atrophic glossitis

Atrophic glossitis is a condition characterized by the loss of filiform or fungiform papillae on the dorsal surface of the tongue, resulting in a change from the normal texture and appearance of the tongue. The papillary protrusion, which normally gives the tongue its characteristic roughness and pattern, is absent, leaving the surface smooth and soft (Erriu and al., 2016).

This situation can be attributed to two primary mechanisms:
- Vitamin deficiency resulting from malabsorption of the nutrient or interference with its metabolism.
- Other mechanisms can contribute to the development of an atrophic condition, including the onset of **candidiasis or hyposalivation** (Erriu and al., 2016).

Cannabis

Smoking cannabis can exacerbate oral and throat inflammation, which may lead to the development of tongue lesions, such as **diffuse atrophic glossitis** (Hermanns-Lé et al., 2013).

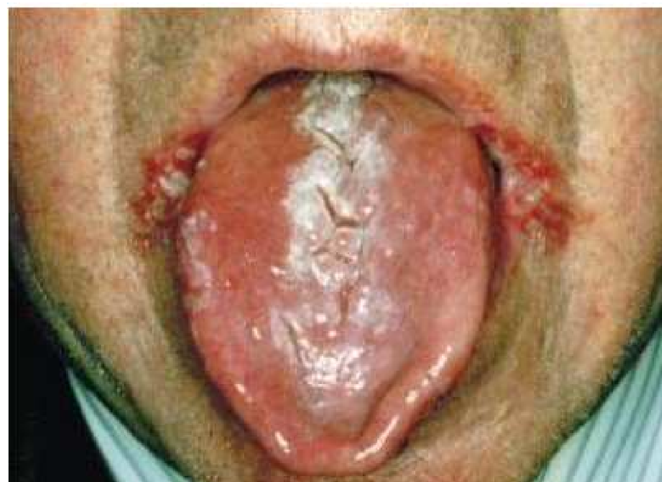

Figure 12 - Chronic lingual candidiasis combining atrophic glossitis (License obtained for its use by the author - Billet & Malard, 2013).

Median glossitis rhombus

Central rhomboid-shaped hyperkeratotic areas are characterized by erythematous plaque-like lesions that may be tender to palpation. Typically, they appear on the central dorsum of the mobile tongue (Sharabi & Winters., 2023).

Cocaine and amphetamine

Glossitis has multiple potential causes, including:
- anemia
- vitamin B deficiencies
- infections, particularly fungal with Candida species
- medications
- poor hydration
- exposure to irritants (alcohol, tobacco)
- mechanical irritation (burns, chronic dental trauma)
- psychological factors (conversion disorders, anxiety) (Sharabi & Winters., 2023).

PWDUD are more prone to develop a glossitis due to all these factors compared to a patient who does not consume.

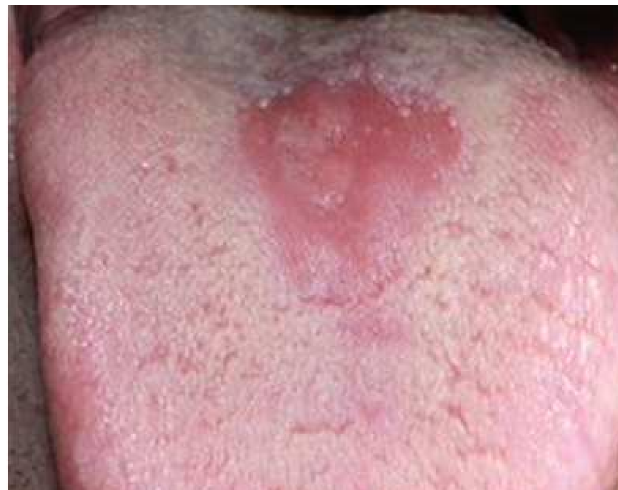

Figure 13 - Median rhombus glossitis (License obtained for its use by the author - Billet & Malard, 2013).

b. Leukoedema

White lesions in the oral cavity are common and have multiple etiologies. Due to their similar clinical appearances, it may be difficult sometimes to differentiate benign white lesions

from their premalignant/malignant counterparts. Leukoedema can be one of these white oral lesions (Jone & Jordan, 2015).

In fact, Leukoedema is a white or grayish lesion that appears in the buccal and labial mucosa of humans. The etiology is not clearly established, but it appears to develop in areas of irritation. Alcohol, tobacco consumption, and bacterial infections also seem to promote its onset (Waitzer & Fisher, 1984).

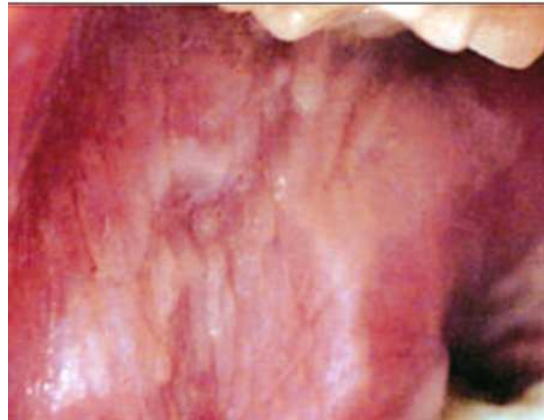

Figure 14 - Intra-oral photography of a leukoedema (License obtained for its use by the author - Kim et al., 2006).

Cannabis

Individuals who consume cannabis are more likely to develop leukoderma compared to non-smokers. Moreover, smoking cannabis can cause thermal irritation, as reported by Saini et al. (2013).

Cocaine

Topical irritation resulting from direct contact of the drug with the mucous membrane can also cause leukoderma (Saini et al., 2013).

c. Candidiasis

Candidiasis, also known as oral candidiasis, is the most common mucocutaneous fungal infection of the oral cavity. It is caused by Candida, a genus of fungi that is commonly found in the oral cavity of 53% of the general population, where it exists as a harmless commensal organism. Of the 150 species of Candida that have been isolated in the oral cavity, 80% are Candida albicans, which can colonize the oral cavity alone or in combination with other species.

The effect of the drug dependence on the oral cavity

This can lead to the appearance of white or red patches, itching, and irritation (Coronado-Castellote & Jiménez-Soriano, 2013).

The causes of development can be:
- poor dental hygiene
- unsatisfactory nutritional factors
- hyposalivation
- immune system failure (Quaranta et al., 2022).

These are factors that are often present among users of illicit substances.

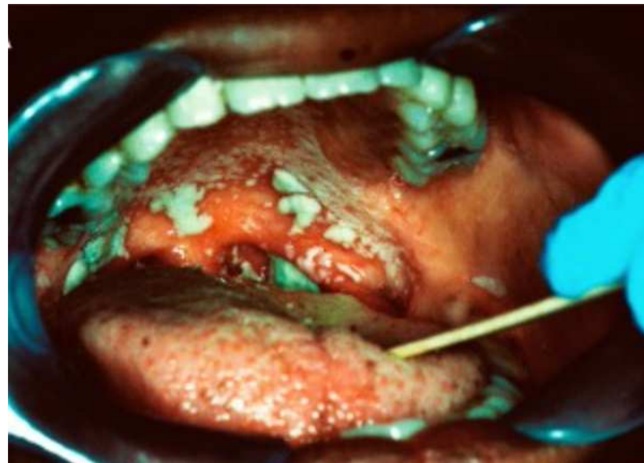

Figure 15 - Oropharyngeal candidiasis characterized by diffuse thick curdy white plaques that could be wiped off with gentle scraping, with extension from the soft palatal mucosa (oral candidiasis) to the oropharynx (oropharyngeal candidiasis) (License obtained for its use by the author - Vila et al., 2020).

Cannabis

A systematic review published in 2008 found that cannabis use has a significant association with increased Candida albicans infections (Quaranta et al., 2022). Furthermore, a review article by Teoh et al. (2019) highlighted the prevalence and density of Candida albicans in cannabis users, suggesting that THC can alter the oral flora.

Cocaine and Amphetamine

Users of PWDUDs are more susceptible to oral infections due to the immunosuppressive effects, hyposalivation, and poor dental hygiene (Saini et al., 2013).

d. Pre-cancerous and cancerous lesions

According to the National Cancer Institute (NCI) definition, "cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body" (Brown et al., 2023). It is one of the leading causes of mortality worldwide (Zaimy et al., 2017).

Cannabis

Consumption of cannabis has been linked to an elevated risk of oral cancer.

Specifically, cannabis smoke contains carcinogenic compounds, including:
- phenol : has the ability to damage cell DNA. When cells are exposed to phenol, this can cause genetic mutations that can lead to the development of cancer cells.
- vinyl chloride : this is due to the formation of reactive derivatives from this chemical compound that can penetrate the cells and wiggle their normal functioning
- aromatic hydrocarbons : the chemical structure of these molecules, linked benzene (or phenol) cycles, confers specific chemical properties that make them carcinogenic (Saini et al., 2013)**.**

Cannabis smoke is **carcinogenic** and has been linked to the development of **premalignant lesions** in the mucous membranes. It is often smoked in combination with tobacco, which is also a carcinogen. Exposure to cannabis smoke has been shown to lead to the appearance of **dysplastic lesions**, including **leukoplakia** and **erythroplakia**. Moreover, it has been linked to the risk of **tongue carcinoma** (Saini et al., 2013). Notably**, cannabis** smoke contains **50% more carcinogenic hydrocarbons** than **tobacco** smoke (Teoh et al., 2019).

Premalignant lesions

- Leukoplakia is the most common premalignant lesion of the oral mucosa. It appears as a white patch or plaque on the oral mucosa that does not scrape off. Leukoplakia is associated with various factors, including infectious, nutritional, and toxic habits. Tobacco use is the primary cause, and many cases resolve or improve after quitting smoking (Grajewski & Groneberg, 2009).

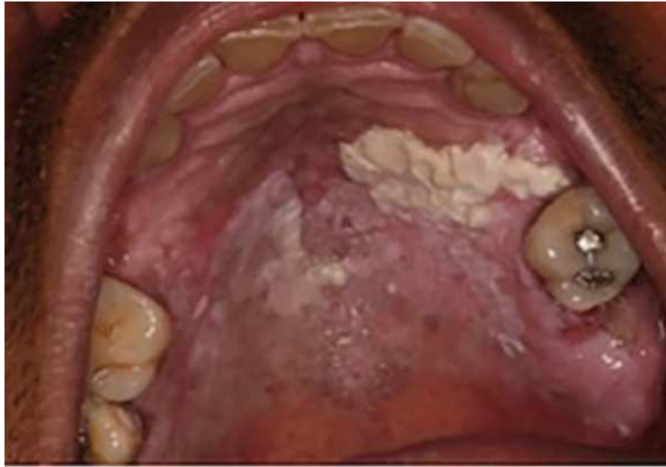

Figure 16 - Oral leukoplakia (License obtained for its use by the author - Cerqueira et al., 2020).

- Erythroplakia is a precancerous lesion that can be observed in the oral cavity. This red lesion is one of the most common epithelial precursor lesions of oral squamous cell carcinoma, like leukoplakia (Grajewski & Groneberg, 2009).

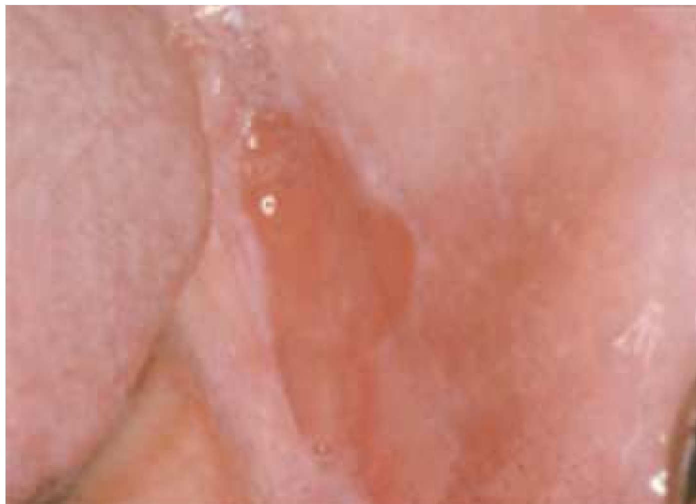

Figure 17 - Oral erythroplakia (License obtained for its use by the author - Holmstrup, 2018).

4.4. The effects of substances on hard tissues

a. Bruxism and fracture teeth

According to Matusz et al. (2022), bruxism is a common medical condition characterized by the habitual clenching or grinding of the teeth, as well as the bracing or

thrusting of the jaw, which can occur during sleep, known as sleep bruxism, or during wakefulness, known as awake bruxism.

Bruxism often causes:
- headaches
- TMJ (Temporomandibular Joints) pain
- masticatory muscle pain
- mechanical tooth wear
- prosthodontic complications,
- cracked teeth (Matusz et al., 2022),

Amphetamines

Bruxism and jaw clenching are prevalent in chronic amphetamine users, as a result of the increased neuromuscular jaw activity caused by the augmentation of noradrenergic neurotransmission in the central nervous system (CNS). Moreover, studies have shown that temporomandibular jaw joint pain and tenderness are common findings among users (Teoh et al., 2019).

A recent study found that approximately 25% of consumers experience discomfort or TMJ pain when they open their mouth to eat, and 28% find it difficult to open their mouths fully (Lowenstein, 2009).

Furthermore, the increased motor activity may also lead to a higher likelihood of tooth fracture (Saini et al., 2013).

Cannabis

The results of a study by Le et al. (2022) suggest that patients who reported using cannabis in their lifetime were more likely to experience bruxism. However, this study is the first to investigate the correlation between cannabis use and bruxism, and therefore further research is needed to fully understand this relationship.

In contrast, contradictory reports have suggested that medical cannabis use can alleviate bruxism. The reason for this finding is currently unclear, but it is possible that a confounding factor may be at play. For example, clinicians have long suspected that psychosocial factors such as stress, anxiety, and depression may be predictors of bruxism. It is possible that the cannabis users in this study may be self-medicating with cannabis to deal with stress-inducing psychosocial factors in their lives (Le et al., 2022).

The effect of the drug dependence on the oral cavity

Cocaine

Cocaine use is often associated with bruxism, temporomandibular joint discomfort, and pain in the surrounding musculature, which may be attributed to the altered dopaminergic neurotransmission (Teoh et al., 2019)."

b. Enamel damages

Enamel is the hardest tissue in the human body (Addy & Shellis, 2006). Despite its hardness, enamel can still undergo wear. There are four types of wear: erosion, attrition, abfraction, and abrasion (Shellis & Addy, 2014).
Despite sharing the same characteristic of worn teeth, the four types differ in their underlying causes and the specific regions of the tooth that are most affected.

- **Erosion** dissolution of hard tissue by acidic substances
- **Abrasion** is a wear produced by interaction between teeth and other materials.
- **Abfraction** is a wear caused by biomechanical loading forces that result in flexure and failure of enamel and dentin at a location away from the loading. This tooth wear manifests at the neck of the teeth.
- **Attrition** is a wear through tooth and tooth contact (Shellis & Addy., 2014).

Illicit substances contribute to premature tooth wear, both directly through their chemical properties and indirectly through their mechanical effects on the teeth.

Cannabis

The cannabis induces enamel erosion by:
- **The cannabinoid hyperemesis** syndrome is a condition characterized by recurrent vomiting, as defined by Leu and Routsolias (2021). Symptoms include severe nausea, vomiting, and abdominal pain. (Saini et al., 2013).
- **The consumption of acidic foods or beverages**, which are common in cannabis users, may also exacerbate this condition. (Saini et al., 2013).

Cocaine

Erosion enamel by:

- Direct chemical effect: when mixed with saliva, cocaine becomes extremely acidic, which erodes tooth enamel and exposes the underlying dentine to decay-causing bacteria (Saini et al., 2013).

- Hyposalivation cocaine reduces saliva lubrication, leading to increased acidity on the teeth (Teoh et al., 2019).

Abrasion through:

- Traumatic brushing or

- Direct application of cocaine on the teeth (Teoh et al., 2019)

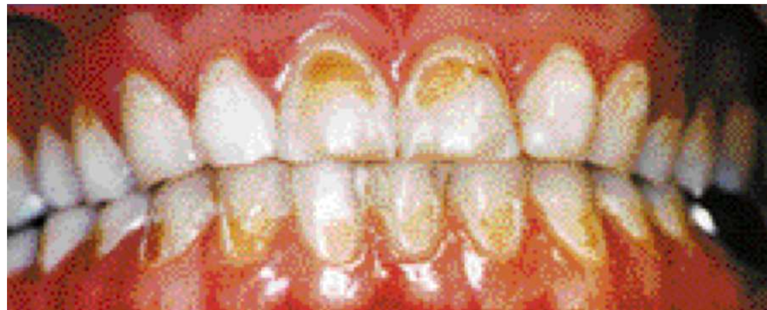

Figure 18 - Cervical abrasions in relation to cocaine, due to direct contact or untimely excessive brushing (License obtained for its use by the author - Hubert-Grossin et al., 2003).

Attrition:

- Bruxism, which is a common side effect of cocaine use, can also contribute to tooth wear. A study published in 2008 found that a patient with a two-year history of regular cocaine use exhibited mild attrition affecting all canines, first premolars, and upper lateral incisors (Brand et al., 2008).

Amphetamines

The amphetamines induce **erosion** by:

- ph acidic: amphetamines themselves, when smoked or inhaled, can cause direct corrosive effects on the oral tissues (Teoh et al., 2019).

- Increased intake of carbonated beverages containing sugar and poorer oral hygiene: compared to the general population (Teoh et al., 2019).

- Hyposalivation: this is due to the sympathetic stimulation of adrenergic receptors, which reduces salivary flow (Teoh et al., 2019).

The effect of the drug dependence on the oral cavity

The amphetamines induce **attrition** by:

- Bruxism: individuals taking amphetamines are at increased risk of developing this situation and can lead to TMJ problems and dental issues (Teoh et al., 2019)

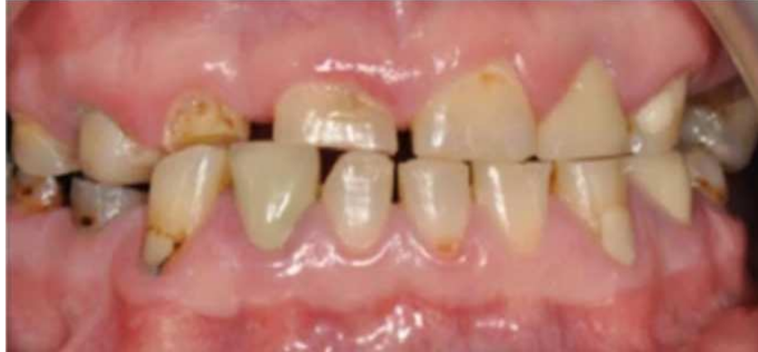

Figure 19 - Attrition due to bruxism (License obtained for its use by the author - Rees & Somi, 2018).

c. Carious lesion

Dental caries is one of the most widespread diseases globally. It arises from the demineralization and cavitation of teeth, triggered by acids produced through the fermentation of sugar by bacteria in dental plaque (Rossow, 2021).

The process begins on the tooth's surface, where demineralization of the enamel occurs, followed by a small roughness that can lead to cavitation, pulp involvement, swelling, and potentially abscess formation (Mathur & Dhillon, 2017).

The progression of the disease can impact:

- the mastication function
- the speech
- smile
- psychosocial environment
- the quality of life.

The prevention is easy and useful. In fact, it is imperative:

- a correct oral hygiene
- a healthy diet
- less sugar (Mathur & Dhillon, 2017).

Carie is more prevalent in individuals addicted to illicit substances. Typically, individuals with substance abuse have a higher amount of plaque on one or more teeth compared to those who do not use substances. Moreover, most users exhibit a high rate of plaque accumulation and tarter deposition. In addition, oral hygiene is often neglected (Saini et al., 2013).

The prevalence of untreated cavitated dentine carious lesions in the permanent dentition among individuals who use illicit substances varies by world region, ranging from 20% to 45% (Rossow, 2021).

Amphetamines

The mouths of methamphetamine users are often referred to as "Meth mouth." This condition is characterized by severe tooth decay, particularly large cavities, and by teeth appearing "blackened, stained, rotting, crumbling or falling apart. In chronic users, the location of caries typically involves the buccal and cervical smooth surfaces of the teeth and the interproximal surfaces of the anterior teeth (Teoh et al., 2019).

A study found that users of this substance were twice as likely to have untreated tooth decay, had two more decayed, missing, or filled teeth, and were four times more likely to have caries compared to non-users (Teoh et al., 2019).

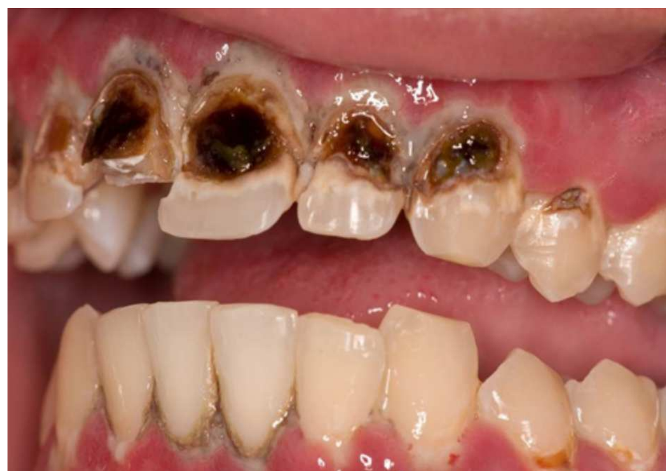

Figure 20 - Clinical presentation of “meth mouth” in a MDMA user. MDMA, 3,4-Methylenedioxy-Methamphetamine (License obtained for its use by the author - Quaranta et al., 2022).

Cannabis

The effect of the drug dependence on the oral cavity

A study on the oral health of cannabis users found that cannabis users had significantly higher levels of tooth decay, more smooth surface caries, less frequent oral hygiene practices, higher consumption of cariogenic beverages, and less frequent regular dental visits compared to the control group (Teoh et al., 2019). Interestingly, cannabis use does not appear to increase the risk of caries on its own (Shekarchizadeh et al., 2013).

Cocaine

Additionally, for cocaine users, the practice of cutting cocaine with sugar significantly increases the risk of cavities (Friedman et al., 2003). A young patient who rubbed cocaine on their frontal gum developed cervical caries on their incisors and canines (Quaranta et al., 2022).

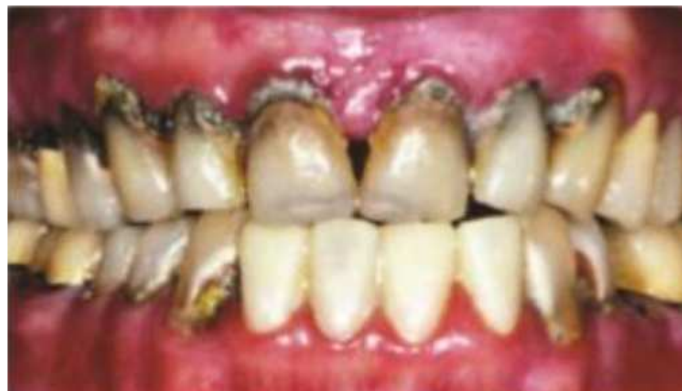

Figure 21 - Cervical caries in a patient using cocaine (License obtained for its use by the author - Hubert-Grossin et al., 2003).

d. Osteoporosis

According to the definition of Glaser and Kaplan, osteoporosis is a skeletal disorder characterized by decreased bone density (mass per volume) of normally mineralized bone. The reduced bone density results in decreased mechanical strength, making the skeleton more susceptible to fracture.

Amphetamines

Kim et al. (2009) conducted the first clinical study to determine the prevalence of osteoporosis in male methamphetamine abusers. Methamphetamine use can lead to osteoporosis and alterations in skeletal structure. Furthermore, decreased bone mineral density increases the risk of fractures. The study has found that individuals who use methamphetamine

have lower bone mineral density compared to those who do not use the substance, despite being of the same age and gender (Kim et al., 2009). The study's findings indicate that methamphetamine users exhibited lower bone mineral density (BMD) compared to age- and gender-matched controls, with a significant loss of bone mineral observed in a substantial percentage of users. Osteoporosis can lead to changes in skeletal structure, and decreased bone mineral density is also associated with an increased risk of fractures (Kim et al., 2009).

e. Perforation of nasal septum and palate

Cocaine

Cocaine use can lead to various orofacial manifestations, such as epistaxis, rhinitis, nasal crusting, and chronic sinusitis. In fact, studies have shown that these nasal complications occur in more than 50% of individuals who snort cocaine (Teoh et al., 2019).

In addition, nasal use of cocaine can lead to centro-facial destructive lesions, commonly referred to as "Cocaine-Induced Midline Destructive Lesions". These lesions often involve perforation of the nasal septum (Blaison et al., 2020).

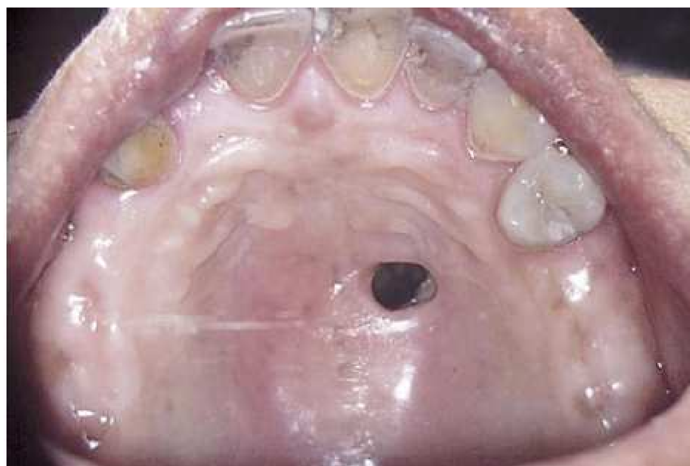

Figure 22 - Intraoral photograph showing palatal perforation in a cocaine-addicted patient (License obtained for its use by the author - Rosas and al., 2006).

Due to the vasoconstrictive properties, which may cause nasal septum ischemia in chronic users, leading to mucosal necrosis and subsequently nasal septum perforation, potentially extending to the hard palate in its midline zone (Lowenstein, 2009).

The effect of the drug dependence on the oral cavity

Studies have shown that nasal septum perforation occurs in 4.8% of users, while palatal perforation has also been reported (Blaison et al., 2020).
Known as the saddle-nose deformity, the perforation of the nasal septum results in:
- a broad flat nose
- strong facial pain
- sensation of nasale obstruction
- hyposmia
- epistaxis (Blaison et al., 2020).

The perforation of the palate can lead to complications, including:
- speech
- eating
- drinking (Teoh et al., 2019).

5. The rehabilitation and the treatment plan for patients with drug use disorders

It is essential to prioritize the treatment plan and assess its timing in close collaboration with the patient, as emphasized by Rossow (2021). Furthermore, such treatments often require a multidisciplinary approach to effectively address and/or reduce the use of illicit substances, thereby ensuring the long-term sustainability of treatment outcomes, as supported by Burrow (2012).

5.1. The reasons for the consultation

a. The rehabilitation

The dental rehabilitation is both **functional** and **aesthetic.**
- **Functionally,** it aims to restore masticatory effectiveness, allowing patients to regain their ability to chew and digest food properly.
- **Aesthetically,** it also enables patients to perceive a better image of themselves, thereby regaining self-confidence and reintegrating into their social and professional lives (Rossow, 2021).

Nevertheless, the rehabilitation must be **fast, effective, and inexpensive**. This is why dental treatment can be challenging, especially when complex treatments are required. As such, complex treatments are typically only undertaken if the patient is in a stable situation with regards to their substance consumption (Rossow, 2021).

b. The pain

Many patients with a history of drug use initially present for **emergency consultations** due to severe pain that brings them to the dental office.
These pains can be caused by:
- cavities
- infections
- periodontal diseases

A significant proportion of PWDUD are anxious about visiting the dentist and may resort to alternative methods to alleviate their pain, such as extractions or abscess drainage. In some cases, self-medication or attempts to relieve toothache can lead to pulpitis or periapical periodontitis (Rossow, 2021).

c. The management of infection

Higher risk of infections

PWDUD are more susceptible to infections due to their **compromised immune system**. This vulnerability is often attributed to:
- poor oral hygiene
- drug consumption methods
- the sharing of contaminated straw
- injection drugs, carry a higher risk of infection (Pitchot et al., 2013).

Furthermore, individuals who use cocaine are at risk of contracting viral hepatitis C (VHC), which can lead to hepatitis B (VHB), or human immunodeficiency virus (HIV), which can result in acquired immunodeficiency syndrome (AIDS). Notably, 14% of individuals who use illicit substances are HIV-positive (Pitchot et al., 2013).

Suppression of infectious foci

It is crucial to eliminate infectious foci that can lead to systemic infections. Infections should be treated promptly to prevent complications. Immunocompromised individuals are at a higher risk of developing severe infections with increased morbidity and mortality. These infections include dental infections and abscesses (Pesci-Bardon & Prêcheur, 2010).

Prophylactic antibiotic therapy

Eliminate chronic infectious foci by initiating prophylactic antibiotic therapy is indicated. The most used antibiotic combination is amoxicillin with clavulanic acid. If there is a penicillin allergy, spiramycin can be used, often in conjunction with metronidazole to target anaerobic bacteria (Pirnay & Pirnay, 2010).

5.2.Tooth preservation

a. Prevention

Prevention is a crucial aspect of the treatment plan. Preventive measures must be implemented to maintain good oral health and prevent further damage. This includes a correct oral hygiene regimen, nutritional advice, and education on the risks associated with illicit substances (Rossow, 2021)

Oral hygiene includes:
- an adequate brushing technique
- the use of a suitable toothbrush
- dental floss
- interdental brushes
- the use of chlorhexidine mouthwashes
- mouthwashes with alcohol are to be avoided to not drying the mouth even more
- the use of fluoride (Rossow, 2021).

The use of fluoride promotes enamel remineralization and inhibits caries formation. Topical applications of fluorine, such as varnish or gel, can be effective, as well as fluoride trays, mouth rinses with fluoride, and prescription fluoride toothpastes (Rossow, 2021).

b. Erosion, attrition, abrasion and abfraction

Multidisciplinary approach

Treatment of PWDUD is particularly challenging, as it involves more than simply replacing lost tooth structure. It also requires identifying and addressing the underlying factors that contribute to tooth loss, including the use of illicit substances (Burrow, 2012).

Restauration

In most cases, restorative treatment involves extensive rehabilitation of the dentition to restore both aesthetic and functional aspects, as well as to prevent further tooth loss (Burrow, 2012).

Current restorative options include:

- **The use of extensive resin composite restorations** is often the initial treatment of choice, as it allows for adjustments and is a reversible and more conservative procedure.
- **The use of indirect restorations** is likely to provide a longer-lasting outcome after initial stabilization, whether it is metal-based, ceramic-based, or a combination of both (Burrow, 2012).

The selection of restorations should be based on the patient's financial situation, current oral hygiene status, and their condition in relation to their substance use (Rossow, 2021).

c. Carious lesion

Dental restauration

Some carious lesions can be treated and restored directly through dental procedures, such as fillings or crowns (Teoh et al., 2019).

Condition

This approach prioritizes care for the most motivated patients, particularly those who have made improvements in their oral hygiene habits and reduced the use of illicit substances. However, it is essential to note that without the patient's motivation, there is a significant risk of caries recurrence (Teoh et al., 2019).

Prevention

In cases of deep caries, antibiotic prophylaxis is recommended for PWDUD at high risk of immunodepression, similar to the use of a dental dam (Pirnay & Pirnay, 2010)

Glass ionomer cement

To restore small cavities, glass ionomer cement (GIC) is the preferred option. Despite its low mechanical properties, GIC can be used for patients at high risk of caries, for active carious lesions, in cases where peripheral enamel is absent, or for patients with limited cooperation. Additionally, GIC releases fluoride that can induce remineralization (Raskin et al., 2022) (Hubert-Grossin et al., 2003).

Amalgam

For certain patients, amalgam may be a more suitable option than resin composite due to its superior strength, durability, and ease application. This is particularly advantageous for patients who suffer from bruxism, as the resistance to mechanical forces is crucial. Moreover, the durability of these restorations is beneficial for patients who do not regularly attend consultations. For uncooperative patients, the ease and speed of amalgam restorations can facilitate the treatment outcome. In contrast, resin composite has a higher risk of developing secondary caries (Hubert-Grossin et al., 2003).

d. Endodontic care

Neglecting dental care for carious lesions or traumatic injuries can lead to complications such as pulpitis. In this scenario, the dentist must assess the most suitable treatment option for the patient. If tooth preservation is selected, measures must be taken to prevent further damage (Rossow, 2021). For endodontic treatment, the use of a dental dam is crucial, and antibiotic prophylaxis is recommended to prevent infections. The treatment should be performed in a single session to minimize contamination (Pirnay & Pirnay, 2010).

e. Treatment of bruxism and joint disorders

To limit pain and the damages caused by bruxism:

- the use of the illicit substances should be reduced or stopped
- behavioral therapies are advised

- medication may be prescribed
- specialized physiotherapy
- gutter can be used (Vavrina & Vavrina, 2020).

Behavioral therapies

Stress, anxiety syndromes, and genetic predisposition appear to be primary factors that contribute to increased muscle tension. As such, behavioral therapies are recommended to manage stress and anxiety. Moreover, relaxation exercises have been shown to improve bruxism (Vavrina & Vavrina, 2020).

Physiotherapy

Specialized physiotherapy can improve tension, pain, and restricted movements (Vavrina & Vavrina, 2020).

Medications

The drug prescription is not the best option, if the patient still consumes. Botulinum toxin treatment has been shown to reduce subjective complaints during its period of action (Vavrina & Vavrina, 2020).

Gutter treatment

Wearing a custom-made occlusal gutter for at least three months has been shown to have a protective function, as it reduces mechanical stress on teeth and a therapeutic function, which includes a decrease in muscle stress, reduced pain, and the ability of the mandible to reposition itself (Vavrina & Vavrina, 2020).

5.3.Non-conservative treatment

a. Dental extractions

Chronic consumption leads to serious problems and often teeth of the patients cannot be treated:

- because of the lack of financial means
- lack of interest for the teeth preservation
- the inability to save the teeth
- too much pain of the patient

Precautions

However, some precautions must be taken:

- the dentist must contact the general practitioner (Saini et al., 2013)
- an antibiotic prophylaxis is recommended to limit infections (Rossow, 2021)
- the dentist should know when the ultimate consumption was (Saini et al., 2013)
- general anesthesia in some cases: too much anxiety, five or more extractions (Pesci-Bardon & Prêcheur, 2010)
- higher risk of bleeding from thrombocytopenia (Lowenstein, 2009)

Complication

PWDUD have an unbalanced diet and malnutrition which impact healing. Immunosuppression can also be a factor in slower healing. Dental alveolitis is more common in PWDUD (Teoh et al., 2019).

Dental alveolitis is an inflammatory process that occurs in the tooth socket after extraction, particularly when the normal coagulation of blood in the cavity is impaired (Laraki et al., 2012).

Few of the symptoms of alveolitis are:

- the pain is intense and persistent
- initially localized
- it tends to radiate to the ear, temple, eye, and neck
- halitosis
- the area becomes reddish
- swollen or edematous (Laraki and al., 2012)

b. Prosthetic rehabilitation

The treatment plan for prosthetic rehabilitation is contingent upon the patient's motivation, oral hygiene, progression in relation to their drug use, and financial means (Rossow, 2021).

In the face of extensive and rapid tooth destruction, as well as the recurrence of caries around restorations within a few months, oral management is often limited to multiple extractions and the placement of removable prothesis (Pesci-Bardon & Prêcheur, 2010).

Fixed prosthesis

Fixed prosthetic rehabilitation with crowns or bridges is feasible when the conditions described above are met. This approach allows for the preservation of teeth to the greatest extent possible (Rossow, 2021).

Fixed dental prostheses have been shown to provide higher patient satisfaction, although they are more costly and require more demanding maintenance (Quaranta et al., 2022).

Implant

Dental implants can be a valuable option, but it is essential to note that a thorough individual evaluation must be conducted prior to treatment (Quaranta et al., 2022).

Moreover, not all patients with PWDUD are suitable candidates for implants due to the condition of the bone, the state of the periodontal tissue, and poor oral hygiene habits (Smeets et al., 2016).

Removable prosthesis

In the face of rapid and extensive tooth destruction, and the re-emergence of caries around restorations within a few months, oral management is often limited to multiple extractions and the installation of a removable prothesis. Full removable prosthetic extractions should be performed in a relatively short period, with no more than five or six appointments (Pesci-Bardon & Prêcheur, 2010).

There are two types of removable prostheses, each with its advantages and disadvantages. The acrylic prosthesis and the skeletal.

Acrylic prosthesis

The acrylic prosthesis can be modified to accommodate changes in the patient's oral cavity and new needs. Additional teeth can be added, if necessary, which is a significant advantage for patients with disabilities or unusual dental conditions, as their dentition may change over time. Furthermore, acrylic prostheses are generally more affordable than skeletal prostheses.

However, there are disadvantages to consider such as:
- for the mandibula, it is little recommended because often patients wait a long time before consulting and the prognostic is not always favorable, due to the advanced stage of osteolysis (Saini et al., 2013)
- must be checked and adjusted regularly: PWDUD attend dental care services infrequently (Rossow, 2021)
- relatively long adaptation period, patients have little motivation for oral hygiene and dental care in general (Rossow, 2021).
- hyposalivation: induces lower retention,
- hyposalivation: induces less comfort (Lowenstein, 2009).
- prosthetic stomatitis: it is an inflammation of the mucosa due to friction of the prostheses and can be caused by hyposalivation (Lowenstein, 2009).
- more fragile than a prosthesis with a metal structure, most have mental health problems, with agitation or outbursts of violence (Rossow, 2021).

Skeletal prosthesis

This prosthesis compared to the acrylic prosthesis has many advantages: more resistant, more stable, and comfortable.

However, for patients, there are disadvantages:
- the price is higher.
- it is not possible to add more teeth.

However, approximately 30% of patients with multiple addictions decline to wear dentures due to various reasons, which ultimately boil down to a simple "I don't like them" (Pesci-Bardon & Prêcheur, 2010). The dentist must therefore recognize the patient's reluctance and agree to focus on a more limited treatment goal, such as "no pain, no infection" (Pesci-Bardon & Prêcheur, 2010).

CIMDL (Cocaine Induced Midline Destructive Lesions) rehabilitation

Some patients with nasal perforations caused by cocaine use cotton or chewing gum to fill the holes. The dental treatment for CIMDL involves the use of maxillofacial prostheses with shutters. To restore phonation and swallowing abilities, a multidisciplinary management

approach is necessary. However, a surgical treatment can only be considered after a minimum of 12 months of complete withdrawal from cocaine use (Nord et al., 2012).

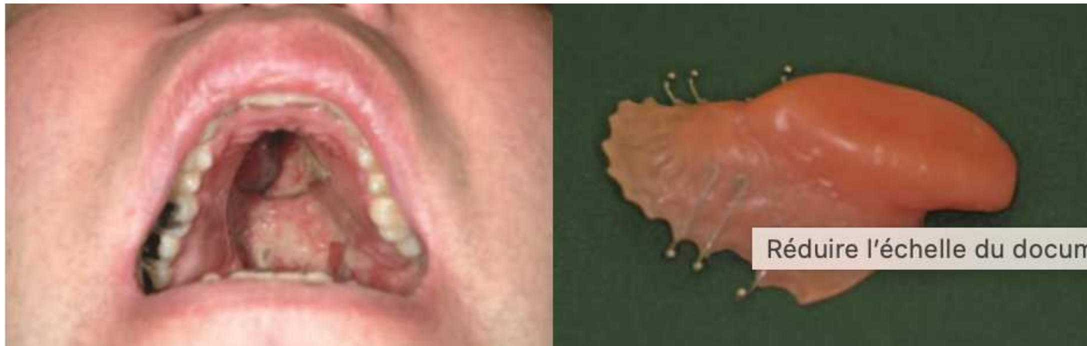

Figure 23 - Intraoral view showing large palatal perforation, and an example of maxillofacial shutter (License obtained for its use by the author - Brand and al., 2008).

5.4. Treatment of oral pathologies

a. Xerostomia

Factors

To effectively treat salivary issues resulting from illicit substance use, it is crucial to cease consumption. This will enable the recovery of a normal salivary flow. However, if illicit substance use is chronic, it may take time to achieve a return to normal (Saini et al., 2013).
In cases of xerostomia where no functional salivary gland tissue is present, symptomatic treatment may be the treatment of choice (Hirvikangas et al., 1989).

To limit xerostomia, it is recommended to not consume:
- alcohol
- coffee
- spicy foods
- tobacco (Millsop et al., 2017).

Hydration

It is crucial to maintain adequate oral hydration, particularly by regularly consuming water. Instead of using mouthwashes containing alcohol, it is recommended to opt for chlorhexidine mouthwashes that are alcohol-free (Rossow, 2021). Moreover, using mouthwashes with alcohol should be avoided as they can further exacerbate dry mouth.

Additionally, chewing sugar-free gum may be beneficial in promoting saliva secretion, and the use of xylitol can also be considered (Quaranta et al., 2022).

Medication

Para-pharmaceuticals and pharmaceutical products may temporarily alleviate symptoms, including dry mouth, which can play a role in the development of oral health problems:

- a lubricating
- moistening
- salivary substitute role
- stimulate salivation (Thakkar & Lane, 2022).

Saliva substitute

- Saliva Orthana®: is a mucin-based product.
- Biotene®: has an antimicrobial action in form of gel (Shahdad and al., 2005)
- Bioxtra® (Shahdad and al., 2005)
- ARTISIAL®: saliva-like composition in form of spray
- AEQUASYA®: spray (Thakkar & Lane, 2022).

General treatment

There are few sialagogue drugs to treat dry mouth, by a general treatment.

- SULFARLEM®: with the active substance anetholtrithione (Hirvikangas et al., 1989).
- SALAGEN®: pilocarpine stimulates the production of saliva (Thakkar & Lane, 2022).

b. Candidiasis treatment

The treatment of candidiasis typically begins with local antifungal therapy in primary care, and is subsequently extended to systemic therapy if the local treatment is ineffective (Saini et al., 2013). Additionally, maintaining good oral hygiene is crucial to prevent the development of other infections.

The duration of treatment varies from 1 to 3 weeks, depending on the patient's clinical response.

Local treatment

- nystatin (Mycostatin®)
- amphotericin B (Fungizone®)
- miconazole (Daktarin®) (Gulalti & Nobile., 2016).

Systemic treatment
- fluconazole (Triflucan®) is prescribed.

Fluconazole is the most potent antifungal agent and the most prescribed class of antifungals for treating both systemic and topical infections. Fluconazole prevents recurrent candidiasis, particularly in individuals who are immunocompromised or have HIV/AIDS (Gulalti & Nobile, 2016).

c. Traumatic oral ulceration

In oral ulcers caused by traumatic factors, treatment involves identifying and removing the irritant. The use of illicit substances should be minimized or stopped, if possible. Once the traumatic factor is removed, wound healing typically occurs within 8 to 15 days (Schemel-Suárez et al., 2015).
In the management of traumatic oral ulcers some steps should be considered:

Step 1: Pain Management
Pain relievers, such as paracetamol, may be prescribed to alleviate pain and reduce irritation. Additionally, oral anti-inflammatory medications may be prescribed to alleviate inflammation (Schemel-Suárez et al., 2015).

Step 2: Cleaning and disinfection
It is crucial to clean and disinfect the ulcer site to prevent infection, which can be effectively achieved using antiseptics such as chlorhexidine 0.12% in rinse or gel form. Additionally, an oral antibiotic may be prescribed to prevent infection, as suggested by Schemel-Suárez et al. (2015).

Step 3: Ulcer Treatment
Traumatic oral ulcers can be treated with topical creams or jellies containing anti-inflammatory agents, antibacterial compounds, or healing agents. Options include creams containing

cortisone or lidocaine. Additionally, adhesive bandages or collars can be applied to the ulcer to protect the site and promote healing (Schemel-Suárez et al., 2015).

Step 4: Pain Reduction

Patients should avoid stimuli that can trigger pain or tension, as this can exacerbate the pain and impede the healing process of ulcers (Schemel-Suárez et al., 2015).

It is better to avoid:

- spicy, acidic, irritating foods
- smoking
- drinking alcohol

d. Gingivitis and periodontitis

The treatment regimen involves professional tooth cleaning and enhanced at-home dental hygiene practices (Quaranta et al., 2022). Antibiotic prophylaxis is recommended for invasive procedures in PWDUD (Pirnay & Pirnay, 2010). Furthermore, precautions must be taken when administering anesthesia to avoid potential complications (Hubert-Grossin et al., 2003).

Oral hygiene

The dentist must clearly explain the importance of oral hygiene to patients, emphasizing the daily removal of plaque using dental floss and toothbrush, with or without antibacterial mouthwash. This is particularly crucial for PWDUD, as they often do not visit the clinic regularly.

It is essential to educate them on the significance of oral hygiene at home and the consequences of substance use on their gums, as they may be at risk of neglecting their oral health (Quaranta et al., 2022).

Necrotizing ulcerative gingivitis

Necrotizing ulcerative gingivitis

At the dental office

- scaling and root planning performed under local anesthesia
- removal of the pseudomembrane using cotton balls soaked in chlorhexidine

- completion of a periodontal assessment following resolution of the acute condition (J Can Dent Assoc**,** 2013).

At home

- provide specific oral hygiene instructions to the patient, including the use of a prescription of a antibacterial mouthwash (chlorhexidine 0.12%) twice daily
- prescribe pain relievers (ibuprofen 400-600 mg) three times daily
- advise the patient on maintaining good nutrition, practicing good oral hygiene, adequate fluid intake, and smoking cessation
- prescribe antibiotics if the patient is immunocompromised or exhibits systemic involvement characterized by fever, malaise, and lymphadenopathy. The options include amoxicillin (500 mg) three times daily for 7 days, or metronidazole (250 mg) three times daily for 7 days (J Can Dent Assoc, 2013).

If left untreated, necrotizing ulcerative gingivitis can lead to the rapid destruction of the periodontium, ultimately resulting in necrotizing ulcerative periodontitis (J Can Dent Assoc, 2013).

Periodontitis

The treatment of periodontitis includes:

- treatment of risk factors for the disease
- scaling: professional cleaning with manual or ultrasonic instruments is essential to remove plaque and tartar
- root planning: the removal of diseased or toxin-infiltrated cementum and dentine, followed by root polishing, is necessary to prevent further disease progression
- careful oral hygiene: patients must practice good oral hygiene habits, including regular brushing and flossing, to prevent the recurrence of disease
- antibiotics may be prescribed: in some cases, antibiotics may be applied locally or systemically to combat the infection
- surgical intervention may be necessary: in severe cases, surgery or extraction may be required to treat the underlying disease (Ubertalli, 2022).

In the case of surgery or periodontal procedures, a hemostatic evaluation should be prescribed (Pirnay & Pirnay, 2010).

A check-up is performed at 6/8 weeks. If the pockets do not exceed 4 mm in depth at this stage, only regular cleaning is required, as reported by Ubertalli (2022).

Necrotizing ulcerative periodontitis

PWDUD are more susceptible to necrotizing ulcerative periodontitis due to their compromised immune system because of HIV/AIDS. In fact, research has shown that nearly 90% of patients with HIV-associated necrotizing ulcerative periodontitis respond favorably to a combined treatment approach, which includes:
- scaling
- root planning
- irrigation of the gingival sulcus with povidone-iodine
- use of chlorhexidine
- systemic antibiotics, usually metronidazole 250 mg orally 3 times/ day for 14 days (Ubertalli, 2022).

e. Glossitis and Uvulitis

Glossitis

Most cases of glossitis are self-limiting and do not require treatment. Symptomatic relief can be achieved through good oral hygiene and mouth rinses. For acute exacerbations of migratory glossitis, certain formulations of "magic mouthwash" containing corticosteroids and lidocaine can provide relief. In some cases, additional specific treatments may be necessary (Sharabi & Winters., 2023).
- atrophic Glossitis: Intramuscular injections of vitamin B12 are recommended for treatment.
- median Rhomboid Glossitis: Antifungal therapy is only necessary if symptoms are present, and treatment typically involves swishing and swallowing nystatin solution (Sharabi & Winters., 2023).

Uvulitis

The treatment depends on the etiology. The study of Guarisco et al., (1988), explains that the inhalation of the Marijuana can lead to the infection with *Streptococcus pneumoniae* and the inhalation with Hashish to the infection with GAS (Group A beta-hemolytic *streptococcus*).

The treatment is antibiotic which acts on *Streptococcus pneumoniae* and GAS.

- Cefuroxime (Zinacef ®)
- Cetriaxone (Rocephin®) (Guarisco and al., 1988).

6. The management of the drug addict during the consultation

6.1.The dentist’s detection role

Many individuals who use illicit substances may not disclose their addiction due to fear of being judged or reported to the authorities. Dentists must be aware of this potential behavior, as some individuals may not admit their addiction, while others may reveal their struggles at the initial consultation or include it in their questionnaire responses (Saini et al., 2013).

a. Observation

Dentists should be aware of the signs and symptoms of illegal drug intoxication and understand the potential effects of these drugs on a patient's overall health. Common signs include a change in the individuals':
- physical appearance
- behavior
- personality
- attitude (Quaranta et al., 2022).

Physical signs or symptoms of substance use include:
- unusual laziness
- unusual body odors
- needle marks
- deterioration in the individual's general appearance
- cleanliness (Quaranta et al., 2022).

Substance abuse should be considered in all patients who present with dental trauma and those who exhibit frequent vague complaints, multiple pain medication allergies, and complex regimens involving multiple narcotic medications (Bullock, 1999).

The effect of the drug dependence on the oral cavity

If there is a suspicion of consumption, a medical examination may be conducted and a thorough review of the patient's medical history should be performed, with a focus on potential infections and nervous disorders (Hubert-Grossin et al., 2003).

If addiction is admitted, then the following questions should be asked:
- What illicit substances do you take?
- When was the last take?
- What are the methods of administration?
- What are the amounts ingested?
- What is the degree of intoxication? (Hubert-Grossin et al., 2003)

b. The behavior of the patient regarding oral health

Neglect of hygiene

Most PWDUD tend to infrequently visit dental offices. This population often faces difficulties in accessing regular oral health services, which can be attributed to economic constraints and limited social coverage. As a result, patients may struggle to cover the costs of care, and medical complications may lead to delayed treatment (Shekarchizadeh et al., 2013).

A study

A study found a significant disparity in dental health status and behavior between individuals with drug addiction and the general population. Long-term drug use either directly contributes to a decline in oral health status or the altered lifestyle of addicts leads to an increased incidence of oral diseases (Saini et al., 2013).

PWDUD often neglect their oral hygiene due to physical and emotional dependence on drugs. Rather than the drug itself, local environmental factors combined with systemic effects of illicit substances use appear to be responsible for the high incidence of dental diseases (Saini et al., 2013).
A retrospective study found that 94% of methamphetamine users had visible plaque on their teeth, compared to 24% of non-users. Additionally, users were more likely to have never brushed their teeth (Quaranta et al., 2022). Furthermore, only 36% of addicts visited the dentist

within a year, and 18% reported brushing their teeth less than once a day, as observed in the Dutch community (Saini et al., 2013).

Unbalanced diet

PWDUD often neglect their nutritional needs, which can lead to the development of gingivitis and periodontal diseases due to impaired nutrition. Furthermore, they exhibit erratic and irregular eating patterns, as reported by Saini et al. (2013). Moreover, their diet is often highly cariogenic, which is also linked to dental diseases, as documented by Teoh et al. (2019).

Psychological

The management of patients with PWDUD is often more complex due to the presence of mental health issues. This is because individuals with PWDUD are at a heightened risk of:
- anxiety
- irritability
- hyperactivity
- restlessness
- agression
- paranoia
- panic
- dysphoria
- violence (Shekarchizadeh et al., 2013) (Teoh et al., 2019).

During treatment, the patient may experience adverse reactions triggered by past experiences and their current mental state (Teoh et al., 2019).

Lack of cooperation

For crack and cocaine users, there may be challenges in conducting a thorough examination during the consultation. Patients may be less cooperative due to pain, which can hinder their ability to provide accurate information. Some patients may refuse to answer clinical history questions or participate in additional oral and intraoral examinations (Cury et al., 2018). Furthermore, some patients may exhibit a sense of entitlement, demanding immediate treatment and becoming resistant to the examination process (Pesci-Bardon & Prêcheur, 2010).

The effect of the drug dependence on the oral cavity

A patient who arrives at the appointment in an intoxicated state should be rescheduled. The patient should be escorted and accompanied to their home by a responsible person, which may include a family member, friend, or caregiver (Saini et al., 2013).

6.2.The interactions with the medications

The use of illicit substances can lead to interactions with certain medications that are potentially serious or even life-threatening. As such, it is essential to remain vigilant for drug interactions and psychoactive substances in patients who use these substances. Additionally, these patients often consume multiple illicit substances, which can increase the likelihood of adverse effects and unwanted interactions (Hubert-Grossin et al., 2003) (Goldstein et al., 2009).

While there is limited scientific evidence on the interactions between illicit substances and drugs, it is worth noting that most drugs are metabolized in a similar form to illicit substances. This can result in elevated concentrations of substances and potentially enhanced side effects of illicit substances.

a. Local anesthesia

When selecting an anesthetic molecule, it is essential to consider the **quality of liver function** and **potential allergic risk** (Hubert-Grossin et al., 2003).
In PWDUD serious liver dysfunction is often observed.

Amide type molecule
Lidocaine and cocaine

As such, caution is necessary when using amide-type molecules like **lidocaine**, which can exacerbate liver damage. Lidocaine acts as a local anesthetic by blocking sodium channels, and its fast-binding kinetics lead to a competitive displacement of cocaine from its receptors. The combination of these two compounds can trigger severe side effects, including:
- seizures
- arrhythmias
- and convulsions (Lowenstein, 2009).

Articaine and mepivacaine

Amide molecules are generally contraindicated, except for articaine and mepivacaine, which have been shown to be **less hepatotoxic** (Lowenstein, 2009) (Goldstein et al., 2009).

Ester-type molecule

Procaine and cocaine

Furthermore, ester molecules like **procaine** are often associated with allergic reactions, particularly in individuals who use cocaine (Lowenstein, 2009).

Cannabis

Some cardiovascular complications can occur in patients that consume cannabis. The effects are dose-dependent:

- **With low or moderate doses** increasing sympathetic activity and decreasing parasympathetic activity, resulting in **tachycardia, and increased cardiac output.**
- **At high doses,** sympathetic activity is inhibited, and parasympathetic activity is increased, leading to **bradycardia and hypotension** (Glover-Bondeau, 2021).

In healthy individuals, these effects are well tolerated but in cannabis users with a pre-existing history of heart disease, such as myocardial infarction or cardiac arrest, the situation is different (Glover-Bondeau, 2021).

There also effects on the respiratory system.

General anesthesia can lead:

- to difficulties in oxygenation and/or ventilation
- bronchial hyperresponsiveness
- increasing the risk of bronchospasm
- increasing the risk laryngospasm
- cases of oropharyngitis
- and uvula edema (Glover-Bondeau, 2021).

There are cases described such as that of a 17-year-old patient who developed acute and non-fatal uvulitis during extubation after a surgery under general anesthesia, after consuming cannabis 4 to 6 hours before the procedure (Glover-Bondeau, 2021).

Propofol

In contrast, research has found that the presence of delta-9-THC in the body counters the sedative effects of propofol. A study of chronic cannabis users revealed that induction doses of propofol during anesthesia needed to be increased by 50-100% due to this antagonistic effect (Glover-Bondeau, 2021).

b. Vasoconstrictors

Cocaine and amphetamines

For anesthesia, it is essential to avoid vasoconstrictors such as adrenaline (epinephrine) and noradrenaline. Cocaine, amphetamines, and vasoconstrictors have a potent interaction. There is a risk that the anesthesia can reach the bloodstream and cause severe cardiovascular complications:

- including hypertension,
- myocardial infarction
- tachycardia
- and even stroke (Hamamoto & Rhodus, 2008) (Carpentier, 1997).

c. Analgesics

Analgesics are often prescribed to manage pain. When prescribing analgesics, it is essential to consider the presence of kidney and liver pathologies (Lowenstein, 2009).

Level 1 analgesic: are peripheral analgesics (for mild to moderate pain) (Guerry & Priser, 2023).

For level 1, increased dosages may be prescribed, except for paracetamol, which should not exceed the therapeutic dosage to avoid hepatotoxicity (Lowenstein, 2009). This phenomenon also applies to individuals who have been detoxified for less than seven months. Research suggests that the endorphin system will likely regain its competence beyond this period (Pirnay & Pirnay, 2010).

Level 2 analgesic: are weak central analgesics (for medium to severe pain) (Guerry & Priser, 2023).

In the case of level 2, dextropropoxyphene is preferred over codeine, such as Diantalvic® (paracetamol-associated dextropropoxyphene) or Propofan® (paracetamol-associated dextropropoxyphene and caffeine), to limit the risks. Codeine is commonly diverted from its medical use (Hubert-Grossin et al., 2003) (Lowenstein, 2009). For patients participating in self-help programs like Narcotics Anonymous, level 2 molecules are also contraindicated to avoid compromising their recovery (Hubert-Grossin et al., 2003).

Level 3 analgesic: are powerful central analgesics (Guerry & Priser, 2023).
It is not recommended to prescribe because of the high risk of diversion for a non-medical purpose and severe interactions with the drug consumption (Guerry & Priser, 2023).

6.3.The behavior to be adopted by the clinician

a. Psychological approach and communication

Psychological approach

During the consultation, there is a significant risk of heightened stress, anxiety, pain, and behavioral disorder. It is crucial to psychologically prepare PWDUD for the consultation. In order to mitigate stress, it is essential to clearly explain the consultation process, the methods used, and the objective to ensure a smoother and more productive experience (Rossow, 2021).

Psychological preparation is generally preferred to sedative premedication due to the potential for interactions between medications and substances consumed (Rossow, 2021).
The initial approach is psychological, as building a trusting relationship is crucial. The dentist must be patient and attentive and remain vigilant when dealing with patients who are experiencing cravings. In fact, these individuals may be impulsive and prone to violent outbursts (Pirnay & Pirnay, 2010).

Communication

Occasionally, psycho-behavioral changes can make cooperation and communication more challenging. In these cases, the professional must strive to provide a continuous and non-judgmental care experience, shifting from a moralistic approach to a more medicalized perspective. (Saini et al., 2013).

Time is need

- for promoting oral hygiene motivation
- teaching a simple oral hygiene method
- checking and reinforcing good hygiene habits at each session
- encouraging and supporting patients through positive feedback and guidance
- demonstrating patience and firmness while maintaining a professional attitude

An improvement in oral hygiene is a indicator of the patient's willingness to continue with care (Rossow, 2021).

Individuals with a painful and aesthetically unappealing dental condition whose anxiety is heightened by the pain and their negative self-image, require a distinct management approach that necessitates a more patient-centered and compassionate communication style from the practitioner. This approach should aim to create a sense of trust and confidence, as the individual has disclosed a sensitive aspect of their life, which can lead to feelings of vulnerability and diminished self-esteem (Pirnay & Pirnay, 2010).

a. Payment

Most PWDUD are unemployed and lack social security coverage. However, there are medical aid services available to support addicts. Practitioners may inform patients about these services. Additionally, various healthcare systems worldwide provide diverse services for addicts, including treatment services, pharmacotherapy, human resources, financing methods, and prevention-and harm-reduction facilities (Shekarchizadeh et al., 2013).

b. Support

Primary and secondary prevention

It is crucial to encourage patients to discontinue their use. Primary and secondary prevention strategies are essential to raise awareness among potential users and new consumers about the risks associated with amphetamine use (Pitchot et al., 2013).

Withdrawal

Regarding withdrawal from psychostimulants, a brief period of rest is often sufficient when symptoms remain moderate. However, more severe manifestations such as major depressive disorder and suicidal ideation may require hospitalization and symptomatic treatment (Pinto et al., 2008).

Multidisciplinary treatment

The dentist can refer the patient to specialists in addiction medicine and to facilities for recovery (Pirnay & Pirnay, 2010). Cognitive-behavioral therapy, a type of psychotherapy, has been shown to help some individuals overcome their dependence on illicit substances. In fact, it has been demonstrated to be effective as a monotherapy treatment and as part of other treatment strategies (Pinto et al., 2008).

No single pharmacological treatment has been shown to be effective in maintaining abstinence. Furthermore, there is no substitution treatment available. Consequently, it appears that the most effective therapeutic approach would be to combine psychotherapy with medication that is likely to reduce craving (Pinto et al., 2008)."

Pregnant women

For pregnant women, the dentist must inform them of the potential risks to their baby. These risks can include mental, physical, and psychological problems. Additionally, some emergency dental procedures may require regional or general anesthesia, which can pose a risk to both the addicted woman and her unborn baby (Saini et al., 2013).

6.4.The precautions to be taken in this type of patient

a. General precautions

Multidisciplinary approach

When assessing a patient's health or conducting a medical examination, there are general precautions to consider, including contacting the attending general practitioner, inquiring about the presence of any pathologies and current treatments (Pirnay & Pirnay, 2010).

Risk of medical emergency

Dental treatments should be postponed for 6 to 24 hours after the use of illicit substances such as cocaine. In fact, there is a heightened risk of medical emergency during dental treatment. Vital signs must be monitored closely to ensure the patient's systemic health remains stable. In fact, during treatment, there is a possibility of increased blood pressure (Saini et al., 2013).

For invasive acts, it is necessary to do an assessment of hemostasis (Hubert-Grossin et al., 2003).

Prevention

The doctor should inform patients about the potential risks and advise them to abstain from consuming substances for at least 24 hours before the appointment. In addition, health professionals should require individuals suspected of using illicit substances to sign a statement confirming that they have not consumed any substances within the past 24 hours. It is crucial to emphasize the importance of patients' complete abstinence from substance use before attending appointments (Saini et al., 2013).

Drug precaution

- The management of anxiety requires caution. The use of nitrous oxide is not recommended due to its potential for hallucinogenic effects and abuse risks. Furthermore, the prescription of benzodiazepines as anxiolytics is not within the scope of a dental surgeon's competence and should only be undertaken by a specialist physician (Pirnay & Pirnay, 2010).

- The prescription drug: PWDUD, may attempt to manipulate the prescriber to obtain psychotropic drugs. The practitioner must adapt their behavior to the situation. It is the responsibility of the prescriber to be vigilant and cautious. To prevent manipulation, prescriptions should be made unfalsifiable with a clear dosage and treatment duration, written in full letter, signed at the bottom of the page and the back of the sheet, and stored with a record of the prescription (Pirnay & Pirnay, 2010).

- Regarding prescriptions: it is recommended that the dental surgeon avoid prescribing opioids and instead refer their patient to addiction specialists for optimal treatment (Pirnay & Pirnay, 2010).

b. Anesthesia

As highlighted earlier, selecting the appropriate anesthetic molecule is crucial, and the use of vasoconstrictors should be avoided. Furthermore, choosing the correct anesthesia

technique is also vital. During anesthesia, some individuals with dental anxiety may exhibit a phobia of needles when treated by unfamiliar providers (Rossow, 2013).

Choice of anesthesia

General anesthesia

Individuals with high levels of anxiety or those who are unable to cooperate during the procedure typically receive general anesthesia. In certain situations, such as multiple extractions, general anesthesia is often considered the preferred option (Lowenstein, 2009).

Local and loco-regional anesthesia

Local anesthesia and local regional anesthesia are often used for patients who are cooperative and experience moderate anxiety, but they can also interact with illicit substances and cause problems. According to Lowenstein (2009), these interactions can have adverse effects on the patient's dental treatment.

For pregnant women, it is challenging to predict the anesthetic implications in drug abusers, whether regional or general anesthesia is administered (Saini et al., 2013).

Local anesthesia

For local anesthesia, doses should be increased compared to those of a healthy individual (Lowenstein, 2009). People with dental anxiety disorders have a lower pain threshold due to increased anxiety and faster metabolism of anesthetic products. As a result, local anesthesia will have a lower efficiency (Carpentier, 1997).

Pain tolerance can be reduced in this population, which is why local analgesics may be prescribed to relieve pain (Saini et al., 2013).

Loco-regional anesthesia

For optimal anesthesia, it is recommended to perform a loco-regional anesthesia rather than a local anesthesia, particularly for immunocompromised patients. This approach minimizes the number of injections and reduces the risk of infection. However, immunocompromised patients may experience more severe and rapid side effects due to anesthesia, as reported by Lowenstein (2009)

Precaution

A 6-24 hour waiting period is recommended after using cocaine, or amphetamine for anesthesia with vasoconstrictor. For cannabis, you must wait a week if you use a vasoconstrictor (Hubert-Grossin et al., 2003).

c. Risk of infection

Certain risks must be known, and precautions must be taken by the professional and PWDUD (Saini et al., 2013).

Virus infection

Injectable drug users are at increased risk of contracting human immunodeficiency virus and hepatitis due to their frequent use of unsterile needles, which can facilitate the transmission of these diseases (Saini et al., 2013).

The patient infected with HIV and/or hepatitis C virus or other bloodborne pathogens poses a risk of accidental contamination to the dental surgeon. This risk is elevated if the patient has consumed alcohol or has taken amphetamines such as "for courage". Furthermore, the risk is increased if the patient has prolonged bleeding due to low platelet or prothrombin levels. Additionally, there is a higher risk of contamination between the patient and the practitioner, particularly when using needles (Pesci-Bardon & Prêcheur, 2010).

Precautions

It is therefore essential to take precautions.

As a precaution it is better:

- perform a meticulous and accurate diagnosis
- take a detailed patient history
- consult with the attending physician
- refer to a specialist if appropriate

To limit the risk of blood contamination protective equipment is used:

- a gown
- gloves
- mask
- visor (Pesci-Bardon & Prêcheur, 2010).

Antibiotic prophylaxis

Antibiotic prophylaxis is essential for invasive procedures such as scaling, surgery, and endodontic treatment.

Indeed, PWDUD are more prone to:
- risk of infectious endocarditis in individuals with a history of intravenous drug use
- risk of infection in patients with severe immunocompromise (thrombophlebitis, septicemia) (Hubert-Grossin et al., 2003).

The antibiotic prophylaxis regimen involves prescribing:
- 2 grams of amoxicillin administered 30 minutes to 1 hour prior to treatment
- 600 milligrams of clindamycin, which is prescribed for patients allergic to beta-lactam antibiotics (Rossow, 2013).

Moreover, for invasive acts, the prevention is before and after the procedure (Hubert-Grossin et al., 2003).

Modulation of the immune response

Cannabis modulates the immune response, exhibiting an immunosuppressive effect on macrophages and B and T lymphocytes. This immunosuppression leads to a decrease in host resistance to bacterial and viral infections, as well as a decrease in lymphocyte proliferation and antibody response. Furthermore, the function of macrophages is impaired due to the suppression of nitric oxide release, while THC alters the secretion of cytokines. Specifically, THC increases the secretion of IL-1 by macrophages. These numerous alterations in host response may explain the severity of periodontal lesions observed in some chronic cannabis users (Lowenstein, 2009).

d. Risk of bleeding

Hemostasis difficulty

Patients who use cocaine or amphetamines, including MDMA and ecstasy, are not suitable candidates for surgical treatment due to the increased risk of bleeding complications. Specifically, post-extraction bleeding has been documented in these individuals, making it essential to consider alternative treatment options.

The effect of the drug dependence on the oral cavity

- Thrombocytopenia is a condition characterized by a decrease in the number of platelets in the blood, which can disrupt the coagulation process. Prior to undergoing surgical procedures, it is essential to perform a complete blood count and clotting screen to ensure proper platelet levels and coagulation function (Lowenstein, 2009).

- Furthermore, there is **an infectious risk** associated with malnutrition or immunodepression. The extraction of teeth in the affected block can facilitate the transfusion of platelets and shorten the duration of the procedure, thereby reducing the postoperative risk of infection (Pesci-Bardon & Prêcheur, 2010).

Monitorization

Monitoring bleeding during **periodontal procedures** is essential. If excessive bleeding is noted, treatment should be stopped, and digital pressure applied. Patients should be referred for medical evaluation and undergo necessary blood coagulation tests before further treatment procedures can be initiated. In the case of extractions, sutures can be placed at the extraction site, hemostatic material deposited in the alveolus, and a tranexamic acid compress applied (Saini et al., 2013).

III. CONCLUSION

Nowadays, the use of psychoactive drugs such as cocaine, amphetamines or cannabis are prevalent around the world. These substances act directly on the brain and its functioning. The consequences on general health and on the hard and soft tissues of the oral cavity are important.

Certain pathologies and clinical signals are common in illicit substances consumers, like bruxism, xerostomia, periodontal pathologies, and candidiasis.

The dentist has a role of screening, relieving pain, aesthetically and functionally rehabilitating the oral cavity, and removing any source of infection. Most PWDUD are immunocompromised and more prone to develop infections by viruses. This is the reason why precautions must be taken for the dentist and the patient.

The management of this type of patient should be multidisciplinary. In fact, the dentist must work in collaboration with the general practitioner and other specialists to ensure the smooth process of care.

It is important to consider a psychological approach, without judgement and refer the patient to structures specialized in addiction. It is also the role of the dentist.

In today's clinical context, it is crucial to incorporate a section on various addictions in the medical questionnaire. This section should comprise inquiries about the use of tobacco, alcohol, cannabis, and other substances. The dentist assumes a crucial role, as they are often the first healthcare professional to encounter these patients.

However, some dentists do not want to treat these patients because there are certain precautions to be take and that it is necessary to adapt their practice to these patients. This is why it is very important for clinicians to have in-depth knowledge of how to work in special conditions, such as these types of patients, which can become more stressful and involve more responsibilities.

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