

Oral health effects, brushing habits and management of methamphetamine users for the general dental practitioner

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IN BRIEF

- Highlights that users of methamphetamine have a higher prevalence of dental caries compared to non-users.
- Reports the results of a study carried out in the Western Cape, South Africa to determine the oral health status of methamphetamine users.
- Suggests that dentists can play a key role in the detection and early management of drug addiction.

Background Methamphetamine is a synthetic drug commonly abused in South Africa and is highly addictive. Users have a higher prevalence of dental caries compared to non-users and the classical caries pattern found in methamphetamine users is termed 'meth mouth'. The increased consumption of soft drinks and the absence of saliva are the main risk factors for 'meth mouth'. **Aim** To determine the oral health status of individuals using methamphetamine. **Method** A cross-sectional study was conducted on a convenience sample of 308 self-reported methamphetamine users at 22 specialised substance addiction treatment centres in the Western Cape, South Africa. **Results** There was a significant difference in tooth brushing frequency when using methamphetamine ($p = 0.000022$; $\chi^2 = 23.84$; OR = 3.25). The mean decayed, missing and filled teeth score was ten and there was an association between the mean number of decayed teeth and the duration of drug addiction ($p = 0.0071$; $\chi^2 = 12.07$). Users who were using methamphetamine for less than four years had fewer missing teeth compared to those who were using methamphetamine for more than four years. **Conclusions** When methamphetamine abuse is detected, the dentist can play a key role in early management of drug addiction by referring the patient to specialised substance addiction treatment centres. In addition, by restoring the dental appearance, users may regain their self-esteem and improve their oral health quality of life.

INTRODUCTION

Substance abuse is a growing public health problem that impacts on law enforcement and healthcare professionals. The main types of drugs abused include opiates, cannabis, hallucinogens, cocaine- and amphetamine-type stimulants, and various club drugs for example, ecstasy and LSD.¹

Drug users seek dental care due to severe dental pain often between drug binges or when they stop methamphetamine abuse.² People with a history of substance abuse present with poor oral hygiene together with severe adverse effects on hard and soft oral structures.

The most common clinical presentation is one of generalised dental caries, periodontal disease, mucosal dysplasia, xerostomia (dry mouth); tooth wear and tooth loss.³ Inadequate oral hygiene, xerostomia, bruxism and an increased intake of sugar-containing beverages are all potential risk factors for dental caries and overall poor oral health.⁴⁻⁶

Methamphetamine, known locally as 'TIK' because of the noise made when the drug is heated in a glass tube, is a common man-made drug in South Africa. It is highly addictive and is associated with serious health problems such as premature labour, birth defects, memory loss, aggression, psychotic behaviour and potential heart and brain damage.⁷ The South African Community Epidemiology Network on Drug Use (SACENDU) is a sentinel surveillance project operational in all nine provinces that monitors alcohol and drug use on a six-monthly basis. SACENDU has reported that methamphetamine is the primary drug of choice when compared to other drugs such as cannabis, methaqualone, cocaine and heroin. The Western Cape Province has the highest number of methamphetamine users with an estimated prevalence of 48% among all patients in treatment programmes for substance addiction in South Africa.⁸

Methamphetamine is used in various ways. It can be swallowed, smoked, ingested nasally or snorted and injected. The drug is readily available, affordable and easily produced.⁹ The classical caries pattern observed in those who use methamphetamine is termed 'meth mouth'. Clinically, it presents as demineralisation of buccal smooth surfaces at the cemento-enamel junction and interproximal surfaces of anterior teeth.⁹ Cavitation is often



Fig. 1 Close-up anterior view maxillary and mandibular incisors



Fig. 2 Occlusal view of the mandibular arch

initiated on the facial and cervical areas of teeth and coronal involvement usually follows¹⁰ (Figs 1 and 2). It has been reported that users have a higher prevalence of dental caries of anterior teeth, premolars and molars when compared to non-users.⁵

Rampant caries, caused by the increased consumption of carbonated drinks and dry

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Table 1 Duration of addiction

Duration of addiction	n	%
0–4 years	98	31.82
5–8 years	131	42.53
9–12 years	74	24.03
More than 12 years	5	1.62
Total	308	100.00

Table 2 Brushing frequency during 'off meth' and 'on meth' use

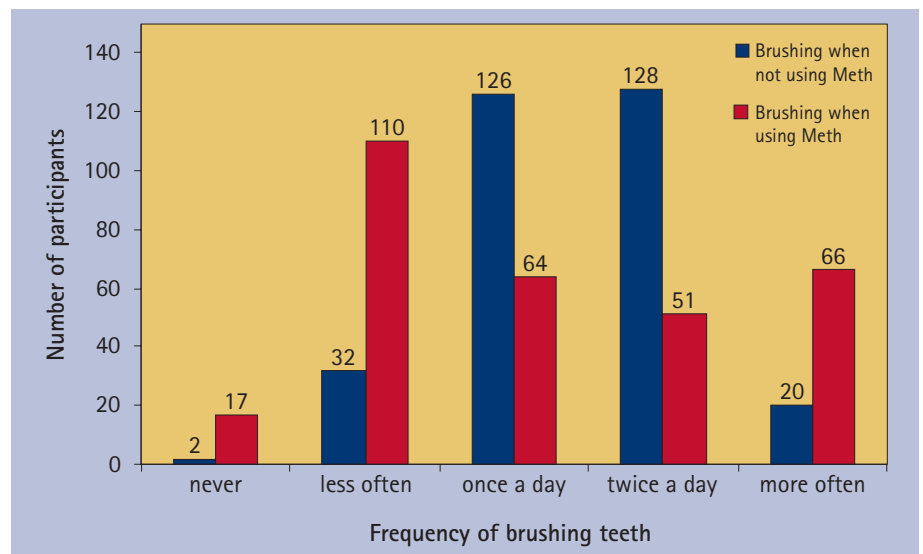
	Off meth		Total
	Frequent	Infrequent	
On meth			
Frequent	77	40	117
Infrequent	71	120	191
Total	148	160	308

mouth are the main risk factors of 'meth mouth'.^{3,5,9,10} Furthermore, the chronic use of methamphetamine leads to serious physiological and psychological effects and are of concern to the dental profession as it can have catastrophic consequences on oral health. Bruxism as a result of drug-induced hyperactivity causes accelerated tooth wear⁴ and deleterious effects on the dentition include tooth fractures and multiple tooth loss leading to edentulism.^{9,10} This paper reports on the brushing frequency and decayed, missing and filled teeth (DMFT) score of participants who were using methamphetamine as a primary drug of addiction. The aim of the paper is to inform GDPs on the oral manifestations of methamphetamine abuse and report on management options available for these patients.

MATERIALS AND METHODS

The aim of the study was to determine the oral health status of individuals using methamphetamine. The study design was cross-sectional and investigated a convenience sample of 308 self-reported methamphetamine users who presented at 22 specialised substance addiction treatment centres. All patients who provided written consent at the time of the visit to each centre were included in the study. Structured, administered questionnaires were used to collect data on demographic information, brushing frequency and the patient's perception on harmful oral effects of methamphetamine.

An intra-oral examination was carried out by the principle investigator (DS) following standardisation and calibration to minimise intra-examiner variability. The oral examination measured dental status and treatment needs (DMFT). The WHO oral health survey

**Fig. 3** Frequency of tooth brushing during 'on' and 'off' drug

guidelines and criteria for determining DMFT were used.¹¹ Information on the DMFT index was captured on a modified WHO oral health assessment form.¹¹ Data was exported to Microsoft Excel 2010, statistical analysis was done by using Epi Info 7 and R and data analysis included t-tests to measure mean scores. Chi square and Kruskal-Wallis tests were used to test for associations.

The research proposal was approved by the Senate Research Ethics Committee of the University of the Western Cape (ref number: 10/05/17), and permission to carry out the study was obtained from the Western Cape Department of Social Development (ref number: 9/2/114/3/2/4) and the City of Cape Town (ref number: 10331). Participation was voluntary and anonymous and signed informed consent was obtained from each patient. Anonymity was assured by not using the participant's names on the questionnaires and the questionnaire was recorded with reference codes. A separate consent form was signed if photographs were taken. Interviews and oral examinations took place in a private room at the treatment centre.

RESULTS

Demographic information

The majority were male (81%), the mean age was 28 years (SD = 6.7) and most participants resided in Cape Town (77.6%). Almost three quarters were unemployed at the time of the study with a mean duration of unemployment of 21.17 months.

History of drug addiction

The mean duration of drug addiction was 6.5 years (SD = 3.1) and the majority (93%) reported that smoking was the primary method of using methamphetamine. Smoking involved heating the drug in a

glass container and inhaling the smoke, and it can also be swallowed, sniffed (snorted) or injected. Almost a third reported that they had been using the drug for four years and 25.63% for nine or more years (Table 1).

A third of the sample reported that they were 16 years and younger when they started using methamphetamine. The mean age at first usage of methamphetamine among the entire sample was 20 years old (SD = 6.5). There was a significant difference ($p = 0.02$) between males and females with regards to age of first usage (males started at the age of 19 years, females at age 21 years). More than two thirds used the drug for more than four years. The majority reported using methamphetamine on a daily (73.38%) or a weekly (23.38%) basis. The mean duration since last usage was 70.33 days. About 12% indicated that they had not used methamphetamine in the past 21 days.

Brushing frequency

Tooth brushing was regarded as frequent when occurring twice or more per day and infrequent when occurring once or less per day. The period when the individual was using methamphetamine was titled as 'on meth' and when not using methamphetamine was 'off meth' (Table 2).

The majority (82.47%) reported that they brushed their teeth either once or twice a day when not using methamphetamine. Nearly half reported that they brushed their teeth less than once a day or never when using methamphetamine. Slightly more than a third (37.99%) brushed their teeth frequently during stages of drug use (Fig. 3). Only a quarter of the sample was brushing frequently during periods of 'on meth' and 'off meth'. The majority (40%) of the sample were brushing infrequently irrespective of being 'on' or 'off' the drug.

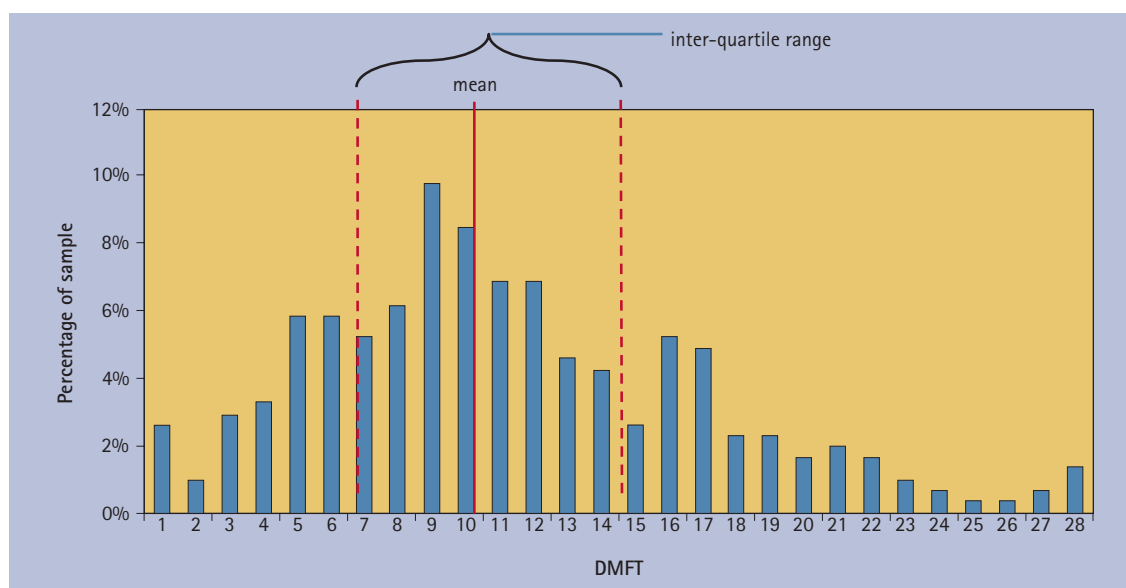


Fig. 4 DMFT distribution of methamphetamine users

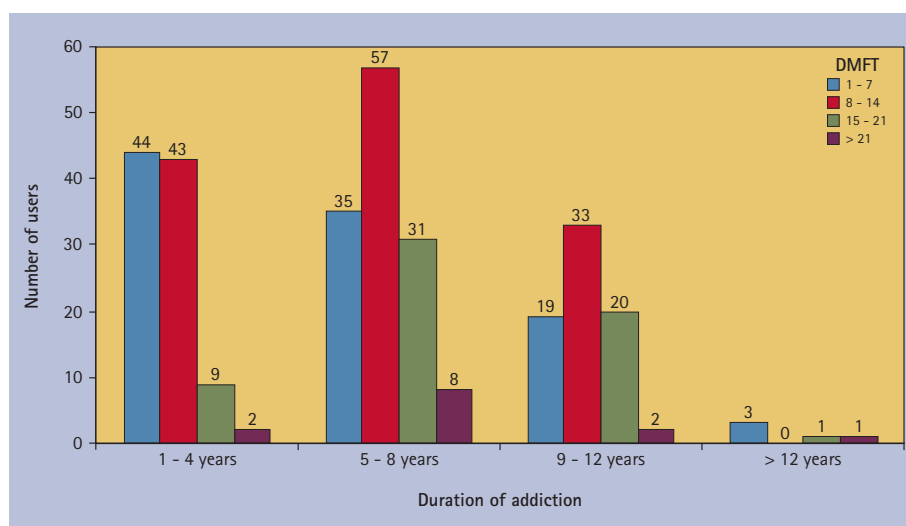


Fig. 5 DMFT and duration of addiction

There was an association between tooth brushing frequency and whether this patient was 'on meth' compared to when 'off meth' ($p = 0.0000022$; $\chi^2 = 23.84$; OR = 3.25). The odds of brushing frequently when being 'off meth' was 3.25 times higher than when 'on meth'.

Decayed, missing and filled teeth (DMFT)

Almost the entire sample (98.05%) had dental caries and the mean DMFT score was ten (Fig. 4). Most users had two to four decayed teeth. The mode for DMFT was eight and the mode for sound teeth was 19. Eight (2.6%) users were caries-free and one user had 21 decayed teeth. Almost a fifth of the sample had a DMFT score of 15–21 (Table 3). The majority of participants (90.58%) had a DMFT score of four and more (95% CI: 86.62–93.5%). The mean number of filled teeth was one and the mean number of missing teeth per person was five. Fourteen percent (14%) of the sample had ten and more teeth missing.

Three users (1%) were completely edentulous. The mean number of decayed permanent teeth per patient was five and the majority of the sample (89.29%) had untreated decayed teeth (95% CI: 85.15–92.41%). There was a 4:1 ratio for missing: filled teeth, meaning that for every filled tooth there were four teeth missing in the cross-sectional methamphetamine user (Table 4).

There was an association between mean DMFT and duration of addiction ($p = 0.003$) (Fig. 5 and Table 5). Users who were using methamphetamine for the shortest duration of time had a lower DMF score of eight, compared to those who were using methamphetamine for longer than four years, who scored 11. Users who were using methamphetamine for the shortest duration of time had fewer teeth decayed, three, compared to those who were using methamphetamine for longer than four years, who each had five teeth decayed.

There was also an association between missing teeth and duration of drug addiction ($p = 0.04$). Users who were using

Table 3 DMFT scores of methamphetamine users

DMFT	n	%	95% CI
0–7	101	32.79	27.62–38.39%
8–14	133	43.18	37.61–48.93%
15–21	61	19.81	15.59–24.79%
>21	13	4.22	15.59–24.49%
Total	308	100.00	

Table 4 Dental status of methamphetamine users

	Mean	SD
Decayed teeth	5	3.71
Filled teeth	1	2.04
Missing teeth	4	4.92
DMFT	10	5.87

methamphetamine for the shortest duration of time, had less teeth missing, three, compared to those who were using methamphetamine for longer than four years, who had five teeth missing.

DISCUSSION

This paper reports on the DMFT and brushing frequency of a sample of methamphetamine users. Dental caries is one of the most prevalent co-morbidities in methamphetamine users.^{4,12–14} The mechanism of action for the high caries levels is a combination of a dry mouth, high sugar diet and poor oral hygiene.¹⁵ Frequent intake of carbonated drinks which contain high levels of sugar and pH levels below the critical pH point of 5.6¹⁴ are also risk factors. A limitation to the study was the fact that the most of the data was self-reported data.

The present study reflected similar demographic characteristics as reported by SACENDU. The majority of users are male, unemployed and in the age group 25–29 years. These demographic characteristics are similar to studies carried out in Australia¹⁶ and in the United States.¹⁷

Poverty, unemployment and a lack of income are serious problems among methamphetamine users.¹⁸ In the present study unemployment was 72%. Henkel found that unemployment was a risk factor for substance use and that the problematic use of illicit drugs can increase the risk of unemployment.¹⁹

In the present study, most of participants had reached high school but had not obtained a senior certificate (passed the last year of high school). Low levels of education were associated with increased numbers of extractions and poor oral health.

The mean DMFT score of the sample was ten and dental status worsened with increasing duration of the addiction. These findings are similar to those supported in the literature.^{3–6,15} Participants complained of the poor dental appearance and functioning caused by the deleterious effects of methamphetamine due to rampant caries and multiple tooth loss leading to edentulism.

The presentation of dental caries and demineralisation patterns among study participants reflected the classical caries pattern of ‘meth mouth’.^{4,13} Cavities were found on buccal smooth surfaces and interproximal areas of anterior teeth. Some researchers have reported that ‘meth mouth’ appeared similar to the caries pattern observed in Sjogren’s syndrome²⁰ and early childhood caries.^{4,14} ‘Meth mouth’ can be explained by chronic dry mouth,^{14,20} inadequate brushing and high sugar consumption.

The severe destruction of dentine and enamel can be explained by a chronic dry mouth, constant grinding of teeth and an increased consumption of carbonated soft drinks and snacks containing high levels of sugar and a poor appetite.²¹ There is strong evidence to support the association between a dry mouth and risk for dental caries due to a decreased buffering effect.²² Other contributing factors can be an increased metabolism and physical activity.^{3,4}

The findings related brushing frequency during ‘on’ and ‘off’ meth usage was in contrast to findings presented by Cunningham *et al.*, and Qian.^{9,12} However, these studies had significantly smaller sample sizes. Others have reported that methamphetamine users were found to rarely brush their teeth⁶ and experienced irregular periods of oral hygiene¹³ which is consistent with present study.

Table 5 Duration of addiction versus DMFT

Duration of addiction	n	Mean DMFT	Variance	SD	%
1–4 years	98	8.52	23.86	4.88	31.82
5–8 years	131	11.26	37.12	6.09	42.53
9–12 years	74	11.01	33.68	5.80	24.03
> 12 years	5	11.2	128.7	11.34	1.62
Total	308	10			

The mean DMFT-score of the sample was ten and dental status worsened with increasing duration of the addiction.

Methamphetamine abuse results in multiple physical, mental and oral health problems. Users are partly responsible for their oral health problems associated by substance addiction because of neglected self-care²³ and often postpone treatment until they experience severe symptoms and when the disease has reached an advanced stage.^{24,25}

Infrequent brushing among methamphetamine users and cariogenic diet preferences further contribute to the deterioration of oral health. The present study showed that brushing frequency during ‘on and off meth’ usage was significantly different when compared to each other. This finding was in contrast to a study done by Cunningham *et al.*³ but concurred with other studies that reported that methamphetamine users were found to rarely brush their teeth⁴ and experienced irregular periods of oral hygiene.⁶

The majority of the participants at substance addiction treatment centres required dental treatment and care, but due to financial constraints, many are not able to receive proper care.

People with a history of methamphetamine addiction are complex to manage when they attend for dental care due to the severe dental destruction. The duration of exposure to methamphetamine is related to the number of teeth that are decayed, missing and filled. Brushing frequency is often low among patients with methamphetamine addiction. The addictive nature of methamphetamine and a lack of support for the user could prolong recovery and rehabilitation.

Dental management

The most important aspect of management is to encourage the patient to stop the abuse of methamphetamine. They need to be informed that the continued use of the drug will result in severe dental, neurological and other complications that will be difficult to treat.

Dental management should address pain and prevent infection before aesthetic concerns are addressed. Basic dental treatment

can be offered at any NHS practice. A comprehensive medical and social history is an essential part of oral health management. Furthermore, patients who present with a classic ‘meth mouth’ should raise suspicion and alert the GDP to ask questions about their social history to determine history of drug abuse.

The approach to oral health management needs to be multidisciplinary with specific emphasis on prevention, promotion, restoring teeth and assessing salivary glands functioning. Regular oral health instruction and education in combination with a determination of patient adherence and participation will shape the core oral health management plan for patients who have a history of methamphetamine addiction.¹³

Dentists can be an integral part of the overall healthcare team as they are able to recognise the oral signs and symptoms of drug abuse.³ Therefore they need to be aware of the clinical presentation and medical signs presented by patients who are methamphetamine users.¹³ In the event of early detection of illicit drug use, it is the dentist’s responsibility to refer the patient to a specialised substance addiction treatment centre. At these facilities, appropriate care can be offered by a multidisciplinary team consisting of a clinical psychologist, social worker, councillor, medical doctor and professional nurse.

Patients who abuse drugs are notoriously difficult to manage due to their lack of compliance with oral hygiene instructions, but they need to be encouraged that good oral health can contribute to improving their oral health quality of life.

Diet and oral hygiene habits

The main objective of dietary advice is to reduce the development and progression of dental caries and improve salivary flow. It could also be beneficial for the patient to consult a dietician because drug abusers often develop a craving for soft drinks and are known for having a poor appetite which may lead to malnutrition and dietary insufficiencies. Patients need to be informed that the consumption of carbonated drinks

and food containing high levels of sugar should be reduced immediately. Improved oral hygiene and a balanced diet will also contribute to the dental rehabilitation.¹³ Patients need to be educated to actively take care of their oral health that is, brushing twice per day with a soft tooth brush, flossing on a regular basis and use fluoridated toothpaste.²⁶ Furthermore, the application of professional fluoride is recommended to stimulate remineralisation and to inhibit demineralisation of tooth structure.

Fluoride

Regular fluoride applications are essential to reduce dental caries progression. Oral rinses containing low levels of fluoride that do not require a prescription may not be sufficient and professionally-applied fluoride is strongly advised. Due to the unpleasant taste of stannous fluoride as well as the potential burning sensations it may cause in the patient with xerostomia, the preferred solution of sodium fluoride (5,000 ppm).³

Xerostomia

Methamphetamine users are xerostomic and therefore the pH of the mouth remains acidic for longer periods. Being xerostomic, the buffering capacity of saliva in tempering the drop in pH is reduced.²⁷ Saliva contains secretory IgA which is an essential component of the immunological defence mechanism in the oral cavity.²⁰

The patient should be advised to drink eight to ten glasses of water each day and avoid consumption of caffeine, tobacco and alcoholic beverages because of their diuretic effects.²⁷ Patients should also rinse their mouth on a regular basis (every hour) with saline solution which is available at pharmacies.²⁶

Other options include salivary substitutes, oral moisturisers and artificial saliva. However, the active agent in these products (carboxymethylcellulose or hydroxymethylcellulose) does not improve viscosity of saliva and is of short duration resulting in only minor relief when compared to water.²⁰ Saliva substitutes may decrease the dental plaque index as well as a lower risk of developing gingivitis and fungal infection.²⁸

The pharmacological stimulation of the salivary glands by using Pilocarpine is another possible method to improve xerostomia. Pilocarpine is an alkaloid, parasympathomimetic drug taken from the *Pilocarpus* plant and acts as a muscarinic-cholinergic agonist and it is responsible for the stimulation of smooth muscle and exocrine glands such as the minor and major salivary glands for increased saliva secretion.²⁶ Recommended dosages are ranging from 2.5 to 15 mg, two to six times per day.²⁹

Pain

Patients often seek dental care due to severe dental pain that they experience between drug binges or after they stop methamphetamine abuse.² A thorough history, examination of the source of the main complaint as well as the present oral status is essential during oral examination.¹³ Local anaesthetics containing vasoconstrictors should be avoided in the case of a patient who took methamphetamine less than 24 hours before the dental visit as it may result in cardiac dysrhythmias, myocardial infarction, and cerebrovascular accidents.³⁰⁻³¹

In addition, special caution also should be taken before prescribing medication to drug addicts due to potential harmful interactions with other drugs for example, opioids. Health professionals should also not make use of prewritten prescription forms because methamphetamine users can sometimes demand pain medication when they refused treatment. Non-steroidal anti-inflammatory drugs are safe to prescribe.²

Preventive measures

The following preventive measures³ are recommended:

- Stimulating saliva flow by means of pharmacologic agents
- Salivary substitutes
- Chewing sugarless gum (the simplest and most likely method to ensure client compliance)
- Increasing fluoride exposure to the oral cavity by administering a neutral fluoride (sodium fluoride 1.1%) to buffer the pH and aid in caries prevention
- Trays, gels, rinses or varnishes could be used
- Drink plenty of water and reduce intake of sugary drinks.

CONCLUSION

Methamphetamine users often present with poor oral hygiene, severe adverse effects on hard and soft oral structures and consequent pathological changes. Inadequate tooth brushing, hyposalivation, bruxism, a poor diet and an increased consumption of sugar-containing beverages are the main contributing risk factors.

The relationship between oral health problems and drug abuse may result from direct exposure during smoking or ingestion but also from physiological changes that occur in the mouth.¹

Studies have found that oral health status of methamphetamine users is worse than that of nonusers. Recognition of the symptoms of 'meth mouth' (association of rampant caries with methamphetamine abuse) could enable the clinician to identify such drug abuse.⁴

People with a history of methamphetamine addiction are often complex to manage as they often present late and have higher levels of decayed and missing teeth. Furthermore, the addictive nature of methamphetamine and a lack of support for the user could prolong recovery and rehabilitation. Dentists have a role to play in the early diagnosis, referral and management of patients addicted to methamphetamine. Restoring the dental appearance will enable users to regain self-esteem and improve their oral health quality of life.

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