

# Methamphetamine abuse: Oral symptoms and dental treatment needs

SADJ May 2016, Vol 71 no 4 p148 - p152

DA Smit<sup>1</sup>, S Naidoo<sup>2</sup>

## ABSTRACT

**Background:** Methamphetamine: a highly addictive drug commonly used in South Africa. Users often present with poor oral hygiene, grossly decayed teeth and complain of a dry mouth. The prevalence of dental caries among users is high.

**Methods:** A cross-sectional study design was used with a convenience sample of 308 self-reported methamphetamine users who were part of an in- or out-patient rehabilitation programme at one of 22 specialised substance addiction treatment centres in the Western Cape.

**Results:** The majority were in their late twenties, unemployed and not satisfied with the appearance of their teeth. A dry mouth and a bad taste were the most common symptoms reported. More than three quarters reported 'stiff' facial muscles and more than half, grinding of their teeth. The most common reason for the last dental visit was toothache and the most common treatment at that visit was dental extraction.

**Conclusion:** Lower levels of education were associated with increased numbers of extractions and a higher probability of poor oral health. Xerostomia, a bad taste and 'stiff' facial muscles were the most common symptoms reported.

**Practical Implications:** A thorough intra-oral examination together with comprehensive note taking is crucial for the management of patients abusing methamphetamine.

**Key words:** Methamphetamine, xerostomia, dental caries.

## BACKGROUND

The United Nations Office of Drugs and Crimes (UNODC) have estimated that about 33.8 million of the global population aged between 15 – 64 years use amphetamine-type

## ACRONYMS

<b>ATS:</b>	amphetamine-type stimulants
<b>CEJ:</b>	cemento-enamel junction
<b>UNODC:</b>	United Nations Office of Drugs and Crimes
<b>SACEDU:</b>	South African Community Epidemiology on Drug Use
<b>NCS:</b>	South African National HIV Prevalence, Incidence, Behaviour and Communication Survey

stimulants (ATS).<sup>1</sup> In 2011, 71% of all ATS-related seizures occurring globally involved methamphetamine. This is a highly addictive drug, commonly used in South Africa.<sup>2</sup> The South African Community Epidemiology on Drug Use (SACEDU) is a sentinel surveillance project active in all nine provinces and is monitoring alcohol and drug use on a six-monthly basis. In the Western Cape, a third of all patients in treatment rehabilitation centres reported using methamphetamine as the primary substance of abuse.<sup>3</sup>

Users present with a classical caries pattern termed "Meth Mouth" that often involves the interproximal and buccal smooth surfaces of anterior teeth.<sup>4</sup> Rampant cavities are often also observed at the cemento-enamel junction (CEJ) and the buccal half of posterior mandibular teeth.<sup>5</sup> Destruction of tooth structure progresses with time and eventually leads to coronal involvement, tooth loss and edentulism.<sup>6</sup> The prevalence of dental caries among methamphetamine users is higher when compared with non-users<sup>7</sup> and poor oral health often leads to a diminished oral health quality of life.

## INTRODUCTION

Methamphetamine can be smoked, swallowed, snorted and injected during drug use. It is a potent central nervous system stimulant.<sup>4,6</sup> The South African National HIV Prevalence, Incidence, Behaviour and Communication Survey (NCS) in 2008 reported that the overall number of treatment admissions for methamphetamine-related abuse significantly increased between 1996 and 2005. However, the prevalence of drug abuse in South Africa is low when compared with that of the United States and Australia.<sup>8</sup>

Methamphetamine is highly addictive, cheap and readily available when compared with other illicit drugs. It causes a combination of adverse physiological, behavioural and

- Dirk A Smit:** BChD (US/UWC), MChD (CommDent)(UWC). Department of Maxillo-Facial- and Oral Surgery, University of the Western Cape, Tygerberg, South Africa.
- Sudeshni Naidoo:** BDS(Lon), LDS.RCS (Eng), MDPH (Lon), DDPH.RCS (Eng), MChD (Comm Dent), PhD (US), Dip Int Research Ethics (UCT), DSc (UWC). Senior Professor and Principal Specialist, Department of Community Oral Health, University of the Western Cape, Tygerberg, South Africa.

### Corresponding author

#### Dirk A Smit:

Tygerberg Oral Health Centre, Private Bag X1, Tygerberg, 7505.  
Tel: +27 21 937 3080, Fax: 086 402 5457 E-mail: dirkiesmit@gmail.com

psychological effects that need to be taken into consideration when treating chronic methamphetamine users.

The general effects of the drug on the user include increased energy levels, a sense of enhanced physical prowess, mental alertness, euphoria and mood elevation which may last for days. An elevated metabolism and increased physical activity often lead to dehydration whilst the drug also acts as an appetite suppressor.<sup>4</sup>

### Physiological effects

Methamphetamine stimulates the central nervous system by causing the release of neurotransmitters into the synaptic cleft. It has a similar chemical structure to that of dopamine and norepinephrine<sup>4,6</sup> and its duration of action is usually 8-12 hours but this can extend up to 24 hours if associated with intoxication.<sup>9</sup> In addition, there is an increase in sympathetic activity causing the stimulation of inhibitory alpha-2 receptors and resulting in vasoconstriction of the capillaries of the salivary glands, leading to a reduction of salivary secretion and consequently a dry mouth.<sup>6</sup>

Lung disorders, kidney damage, hyperthermia, stroke and cardiac arrest are some of the consequences that may follow drug abuse.<sup>4</sup> Skin lesions, unexplained motor activity,<sup>10</sup> as well as an anorexic effect are common associated afflictions.<sup>4,6</sup>

### Behavioural effects

Users are often paranoid and display violent or aggressive behaviour during times of usage<sup>4,10</sup> and they neglect their personal hygiene.<sup>4</sup> Methamphetamine users also have a tendency to consume large amounts of alcohol and cigarettes when compared with non-users.<sup>11</sup>

### Effects on the oral cavity

Methamphetamine users have higher DMFT scores with significantly more decayed and missing teeth compared with non-users.<sup>11</sup> In most cases, users present with poor oral hygiene, grossly decayed teeth and complain of a dry mouth. The destruction of hard tissues can be explained by an increased intake of sweetened, carbonated drinks and foods containing high levels of sugar. Unhealthy diet preferences combined with a chronic dry mouth result in catastrophic effects on oral health due to the absence of protective saliva.<sup>4,6,7,12</sup>

Bruxism during drug use as a result of hyperactive facial muscles leads to accelerated tooth wear<sup>6</sup> and other symptoms such as temporomandibular joint (TMJ) disorders, myofascial pain and trismus.<sup>13</sup>

The classical caries pattern observed in methamphetamine users is referred to as "Meth Mouth" and it affects the interproximal and buccal smooth surfaces of teeth. Teeth are often darkly stained and have a crumbling appearance.<sup>4,13</sup> Demineralisation of tooth structure usually starts at the CEJ since cementum is less resistant than enamel. Initially the cavities are V-shaped<sup>13</sup> at the cervical area of the teeth and eventually progress to frank coronal involvement.<sup>6</sup>

### Methamphetamine mouth symptoms

The most common oral symptom experienced by methamphetamine users is xerostomia.<sup>4,6,14</sup> The decreased salivary secretion is caused by vasoconstriction of the blood vessels in salivary glands<sup>4</sup> and results in an increased risk for dental caries.<sup>15</sup> A dry mouth contributes

further to difficulties in speaking, swallowing, unpleasant taste sensations and burning mouth symptoms.<sup>16</sup> It also leads to a sore mouth that makes food intake difficult.<sup>15</sup> In addition, xerostomia may contribute to the inflammation of soft tissues and other fungal infections such as candidiasis, cheilitis and glossitis.<sup>13</sup>

Prolonged neglect of oral hygiene causes gross accumulation of plaque which is colonised by acidogenic bacteria that continue to metabolize the sugar into acids leading to low pH levels in the mouth.<sup>13</sup> The cariogenic properties of soft drinks can be explained by the high levels of sugar which are broken down by bacteria and cause demineralisation.<sup>10</sup> During periods of high intake of soft drinks and sweet foods, the oral pH level drops below the critical oral pH point and erosion and decay of tooth structure usually follows.<sup>10</sup>

This paper reports on the oral and dental symptoms as well as the dental treatment needs of methamphetamine users.

## MATERIAL AND METHODS

A cross-sectional study design was used with a convenience sample of 308 self-reported methamphetamine users who were attending in- or out-patient rehabilitation programmes at one of 22 specialised substance addiction treatment centres in the Western Cape. Most of the sites were located in the City of Cape Town, a health district within the Western Cape Province. The area is bordered by Atlantis, Worcester, Helderberg and the Cape Point sub-districts.

Ethical approval was obtained from the Senate Research Ethics Committee of the University of the Western Cape on the 23rd of July 2010 (ID number: 10/05/17), the Department of Social Development on the 30th November 2012 (ID number: 9/2/114/3/2/4) and the City of Cape Town on the 12th of December 2012 (ID number: 10331). Participation was anonymous and voluntary. After informed consent was obtained, researcher-administered questionnaires were used to collect oral health status data. If photographs were taken, a separate consent form was completed. An oral examination was performed to measure DMFT and to determine dental needs. The WHO Oral Health Survey guidelines and criteria for determining DMFT were used.<sup>17</sup> The oral examination was carried out using a plane mirror and dental curved probe, and no radiographic examinations were performed. All oral examinations and interviews were conducted by the calibrated principal investigator (inter-examiner = 0.873). Data was captured on Microsoft Excel 2010<sup>®</sup> and statistical analysis was completed using Epi Info<sup>™</sup> 7 and R<sup>®</sup>.

## RESULTS

Twenty two substance abuse treatment centres were visited and 308 participants who were using methamphetamine were included in the study. The majority (69%) of participants were male and almost three quarters (72%) were unemployed. The mean age was 28 years and half were aged between 21-25 years. Most of the participants resided in Cape Town. Slightly more than a quarter (27.27%) reported visiting a dentist in the last six months and about 40% mentioned that their last visit had been in the past twelve months (Table 1). The majority (56.17%), however, recorded that their last dental appointment was more than a year ago. Eleven patients indicated that they had never been to a dentist. The most common reason for going to the dentist was a toothache (67.5%). Other reasons for

**Table 1: Last dental visit**

Last dental visit	n	%
In the last 6 months	84	27.27
About a year ago	40	12.99
More than a year ago	173	56.17
Never	11	3.57
<b>Total</b>	<b>308</b>	<b>100.00</b>

attending a dentist were a check-up, chipped teeth or a cleaning. Only 7.58% mentioned that they required fillings and about five per cent had attended for a cleaning or because of chipped teeth. Less common reasons for going to a dentist were for dentures, bad breath or crooked teeth. The least common reasons were to remove wisdom teeth or having loose teeth.

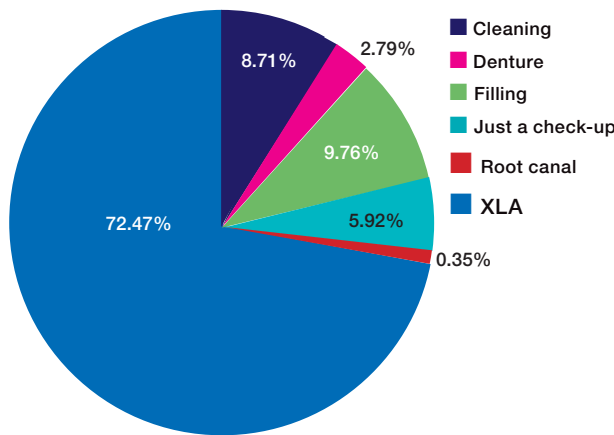


Figure 1: Treatment received at last dental visit.

The last dental treatment received was also investigated. The most common treatment received during their last dental visit was a tooth extraction (72.47%). Other procedures such as restorations (fillings) (9.76%) and cleaning (8.71%) were much less common. Only 5.95% indicated that a check-up was the only treatment they received at their last visit (Figure 1). More patients received fillings (9.76%) compared with the proportion that initially visited for fillings (7.58%). Almost double the number who attended for a cleaning (4.33%) actually received a cleaning (8.01%). These contrasts indicated that participants had a skewed perception of their own oral health status.

Almost two thirds (63.31%) were not satisfied with the appearance of their teeth and 73.31% indicated that their teeth had changed since they have started using methamphetamine. More than half (53.57%) of the sample was satisfied with the functioning of their teeth at the time of the interview.

**Oral health symptoms experienced while using methamphetamine**

A dry mouth (93.51%) and a bad taste (91.23%) were the most common symptoms experienced during times of methamphetamine use (Figure 2). Almost three quarter (73.38%) reported stiff facial muscles and more than half (59.74%) were grinding their teeth during usage. There was an association between grinding teeth and stiff facial muscles ( $p = 0.00024$ ;  $OR=2.6$ ; 95% CI: 1.54 – 4.36). Those who experienced grinding were 2.6 times more likely to experience stiff facial muscles compared to those who were not grinding their teeth.

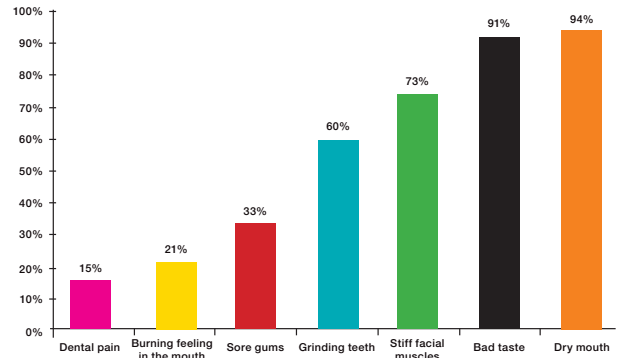


Figure 2: Oral symptoms experienced during usage of Methamphetamine

Other symptoms that were less common included sore gums (33.44%) and a “burning” sensation in the mouth (21.1%). There was an association between gender and sore gums ( $p = 0.013$ ;  $RR=1.5$ ; 95% CI: 1.09 – 2.04). Women were 1.5 times as likely to have sore gums when compared with men. Only 47 (15.26%) of participants indicated that they had suffered toothache when using the drug.

The majority (80.2%) reported a poor /very poor appetite when using methamphetamine; however there was no significant influence found when the daily amount of drug used was considered. Only seventeen per cent reported their appetite was normal during drug use (Table 2).

**Table 2: Appetite when using methamphetamine**

Appetite	n	%
Very good	1	0.32
Good	8	2.60
Normal	52	16.88
Poor	115	37.34
Very poor	132	42.86
<b>Total</b>	<b>308</b>	<b>100.00</b>

The majority (93.52%) indicated that the duration from the time they started using methamphetamine until they experienced a dry mouth was less than an hour (Figure 3). Almost a third reported that their mouth was dry within five minutes. Some participants reported that a dry mouth was an indication that they had reached the point of “being high”.

The duration of time that occurred for the mouth to return to ‘normal’ was also determined and three quarters

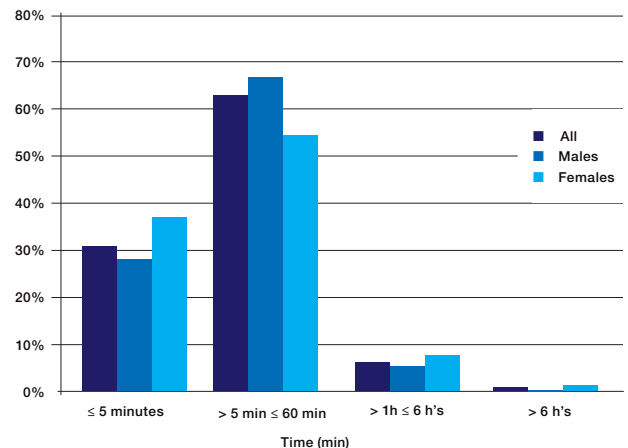


Figure 3: Time from start using methamphetamine until experiencing a dry mouth

**Table 3:** Time from last methamphetamine usage until experiencing normally salivated mouth

Time until normal	All participants	Females	Males
0 ≤ 60 min	6.14%	10.87%	3.98%
1 ≤ 24hrs	77.82%	75.00%	79.10%
1 ≤ 7 days	14.33%	11.96%	15.42%
> week	1.71%	2.17%	1.49%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

of the respondents indicated that recovery of the mouth required between one and 24 hours after the last usage of methamphetamine (Table 3). About 15% indicated that their mouth remained dry for more than a day.

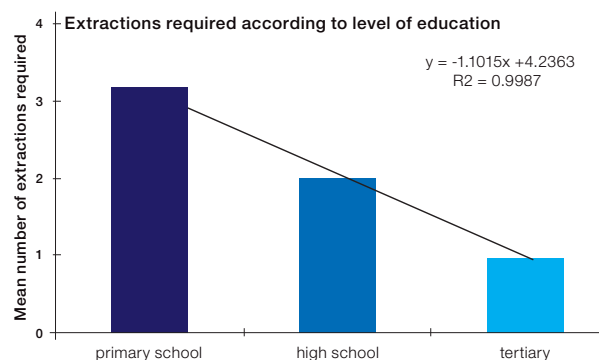
### Perception on aesthetic appearance and functionality of teeth

The majority (82.74%) of the participants indicated that their teeth had changed in some way since the start of their drug addiction. Nearly a third (30.80%) reported that their teeth had 'broken down' and 17.54% said: "their teeth had become rotten". A few users reported that their teeth had become 'weaker' (3.79%) or/and chipped (3.79%). Almost a third (29.38%) reported a change in tooth colour. Actual discolouration of teeth was reported by slightly more than a quarter (26.83%), two thirds of whom (67.44%) considered that their teeth had stained yellow and 13.95% identified a brown discolouration. Other colours of discolouration which were less common were black, blue, off-white and white spots.

### Dental treatment required after clinical examination

The most common dental treatment required was dental extractions. One fifth of the sample required at least one extraction while 13% required at least two. The mean number of extractions required per user was two teeth. One participant, who had been using methamphetamine for 13 years, had multiple severely carious teeth. He required 19 extractions.

The highest levels of education received by participants were categorised into primary school, high school and tertiary institution. Those who attended tertiary education were associated with the least number of required extractions ( $p = 0.003$ ). The number of extractions that were required for the different education groups was significantly different ( $p = 0.005517$ ). Figure 4 is a plot of the mean number of extractions required against the level of education. Users who had reached a tertiary level of education required on average one extraction compared with those who had reached high school, who required



**Figure 4:** Association between the number of extractions required and level of education

two extractions. Those whose education was limited to primary school required on average three extractions. Statistical regression analysis demonstrated how closely the data fitted the line of regression ( $R^2 = 0.9987$ ).

## DISCUSSION

The demographic information of participants reflected similar results reported by SACENDU for 2013 in that the majority of users are male and in the age group 25-29 years.

A dry mouth makes speaking, swallowing and eating very difficult and results in users consuming large amounts of carbonated sugary drinks to quench their thirst. A dry mouth was the most common symptom experienced by users and this concurs with the literature.<sup>4,14,18</sup> The most likely cause of a dry mouth is the activation of alpha-adrenergic receptors which lead to vasoconstriction of the vasculature of salivary glands and a decreased saliva secretion.<sup>19</sup> Other contributing factors can be an increased metabolism and physical activity.<sup>4,6</sup>

There is strong documented evidence to support the association between saliva and the risk for dental caries due to a decreased buffering effect.<sup>20</sup> Users often present with high caries experience and excessive tooth wear that worsened with the increasing duration of addiction. The severe destruction of dentine and enamel can be explained by a chronic dry mouth, constant grinding of teeth and an increased consumption of sweetened, carbonated soft drinks, snacks containing high levels of sugar and a poor appetite.<sup>21</sup>

A dry mouth and a bad taste were the most common symptoms and, together with other symptoms such as the grinding of teeth, this finding is consistent with other studies reported in the literature.<sup>6,22</sup> It was interesting to note that participants regarded a dry mouth as an indication of having reached a "high". Most users reported that the time that elapsed from the last use of the drug until experiencing a 'normal' mouth was about 24 hours.<sup>23</sup>

The classical "meth mouth" caries pattern on buccal smooth surfaces and interproximal areas of anterior teeth can be explained by the chronic dry mouth.<sup>24,25</sup> This caries pattern is similar to that described in Sjogren's syndrome<sup>24</sup> and irregular periods of oral hygiene are common among methamphetamine users.<sup>14</sup>

Lower levels of education were associated with increased numbers of extractions and a higher probability of poor oral health.

Users often presented for dental care with advanced stages of tooth decay and severe dental pain. This was the reason that extractions were the most common treatment provided. Complex restorative and surgical management was mostly required to ensure complete oral rehabilitation after prolonged periods of substance abuse.

Methamphetamine users are difficult to manage, the challenge being how to reduce the consumption of carbonated drinks and high sugar diet. Furthermore, users often have financial constraints making it difficult to afford the complex dental treatment that may be required.<sup>12,26</sup> Patients are notoriously non-compliant, resulting in frustration with failure to keep follow-up visits planned for rehabilitative

treatment, oral health promotion and education initiatives. Psychosis and paranoia are adverse effects of chronic methamphetamine abuse that can last for years even after the drug abuse habit has been overcome.<sup>27</sup>

Although dental pain was not always prominent during times of methamphetamine usage, participants did indicate they often had episodes of tooth ache during abstinence. Very severe pain resulted in a relapse to drug dependence when the patient used methamphetamine to bring pain relief.

## CONCLUSION

Methamphetamine abuse remains a serious public health problem in South Africa and in the rest of the world. It causes numerous dental problems and reduces the oral health quality of life. Dental caries is very common among users but in many cases the seeking of dental treatment is delayed for a year or even longer due to a number of reasons. Xerostomia and other symptoms such as a bad taste, grinding of teeth and stiff facial muscles are the most common symptoms experienced. A chronic dry mouth combined with high-sugar and carbonated drinks intake causes rampant caries that has a classical pattern known as "Meth Mouth".

A dental extraction is still the most common treatment option for methamphetamine users. However, consideration should be given to a more preventive approach that includes oral health instructions, education on good dietary and brushing habits while users are in treatment programmes. It is recommended that there should be more public awareness of the deleterious effects of sugar and carbonated sugar-sweetened drinks and the destructive nature of methamphetamine abuse on oral health.

A thorough intra-oral examination together with comprehensive record keeping is crucial when attending to dental patients who are methamphetamine users. The likelihood of detecting a patient with a drug addiction habit will be increased if dentists are better informed on the signs and symptoms of substance abuse. The rationale for increased professional and public awareness will lead to early detection which will facilitate appropriate management.

## References

1. UNODC. World Drug Report 2013, Amphetamine-type-stimulants, Available from <<http://www.unodc.org/wdr/en/ats.html>> Accessed on 28 Jan 2014
2. Olkkola KT, Ahonen J. Drug interactions. *Curr Opin Anaesthesiol* 2001; 14:411-6.
3. Dada S, Burnhams NH, Parry C, Bhana A, Rule C, Kitshoff D, Nel E, Weimann R. Monitoring alcohol and drug abuse trends in South Africa (July 1996 – December 2012), SACENDU Research Brief 2013; 16.
4. Shaner JW. Caries associated with methamphetamine abuse. *J Mich Dent Assoc* 2002; 84: 42-7.
5. Naidoo S., Smit DA. Methamphetamine abuse: a review of the literature and case report in a young male. *SADJ* 2011; 66 (3): 124-7.
6. Goodchild JH, Donaldson M. Methamphetamine abuse and dentistry: a review of the literature and presentation of a clinical case. *Quintessence Int* 2007; 38: 583-90.
7. Morio KA, Marshall TA, Qian F, & Morgan TA. Comparing diet, oral hygiene and caries status of adult methamphetamine users and non-users. *JADA* 2008; 139: 171-6.
8. Peltzer K. Illicit drug use and treatment in South Africa: A Review. *Substance Use Misuse* 2011; 45(13): 2221-43.
9. O'Brien CP, Gardner EL. Critical assessment of how to study addiction and its treatment: human and non-human animal models. *Pharmacology and Therapeutics* 2005; 108(1): 18-58.
10. Richards JR., Borgfeldt BT. Patterns of tooth wear associated with methamphetamine use. *Journal of Periodontology* 2000; 71(8): 1371-14.
11. Cunningham M, Marshall T, Guzman-Armstrong S, Qian F. 'Oral hygiene behaviours of methamphetamine users', Paper presented at the 2011 IADR General Session, San Diego, California, 16 – 19 March 2011.
12. Klasser GD, Epstein J. Methamphetamine and its impact on dental care. *J Can Dent Assoc* 2005; 71: 759-62.
13. Heng, CK, Badner VM & Schiop LA. *Meth Mouth*. *New York State Dental Journal* 2008; August/September: 50 - 51.
14. Hamamoto, DT, Rhodus NL. Methamphetamine abuse and dentistry. *Oral Diseases* 2009; 15 (1): 27-37.
15. Macknely A., Day, J. A survey of techniques to reduce and manage external beam radiation-induced xerostomia in British oncology and radiotherapy departments. *Radiography* 2009; 15: 283 – 91.
16. Vidović Juras D, Lukac J, Cekić-Arambasin A, Vidović A, Canjuga I, Sikora M, Carek A, Ledinsky M. Effects of low-level laser treatment on mouth dryness. *Colegium Antropologicum* 2010; 34 (3): 1039-43.
17. World Health Organization. *Oral health surveys: basic methods – 5th ed.* 2013 WHO, Geneva, Switzerland.
18. McGrath C. & Chan B. Oral health sensations associated with illicit drug abuse. *British Dental Journal*, 2005; 198 (3): 159-62.
19. Saini T, Edwards PC, Kimmes NS, Carroll LR, Shaner JW, Dowd FJ. Etiology of xerostomia and dental caries among methamphetamine abusers. *Oral Health Prev Dent* 2005; 3: 189-95.
20. Garcia-Godoy F, Hicks MJ. Maintaining the integrity of the enamel surface: The role of dental biofilm, saliva and preventive agents in enamel demineralization and remineralization. *J Am Dent Assoc* 2008; 139: 25-34.
21. Ravenel MC. Methamphetamine abuse and oral health: a pilot study of "Methamphetamine mouth." *Quintessence international* 2012; 43(3): 229-37.
22. Turkyilmaz I. Oral manifestations of "meth mouth": a case report. *J Contemp Dent Pract* 2010;11:E073-80.
23. Lake CR, Quirk RS. CNS stimulants and the look-alike drugs. *Psychiatr Clin North Am* 1984; 689-701.
24. Rhodus,NL, Little JW. Methamphetamine abuse and "Methamphetamine mouth". *Northwest Dentistry* 2005; 84: 29, 31, 33 -7.
25. Shaner JW, Kimmes N, Saini T, Edwards P. "Methamphetamine mouth": rampant caries in Methamphetamine abusers. *AIDS Patient Care STDS* 2006; 20: 146-50.
26. Williams N, Covington JS, Methamphetamine and meth mouth: an overview. *J Tenn Dent Assoc* 2006; 86: 32-5.
27. Davidson C, Gow AJ, Lee TH, Ellinwood EH. Methamphetamine neurotoxicity: necrotic and apoptotic mechanisms and relevance to human abuse and treatment. *Brain Res Brain Res Rev* 2001; 36: 1-22.