Effect Of Methamphetamine On The Oral Cavity - A Systematic Review

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ABSTRACT

AIM:- To assess the effect of Methamphetamine on the oral cavity.

METHODOLOGY:- A systematic review of research articles was performed. Electronic and hand searches retrieved 220 records; out of this, 164 were screened. In addition, the intervention and outcomes were assessed in the study included for the review.

RESULT:- This systematic review included five studies. These studies assessed the association of various oral symptoms with the immoderate usage of Methamphetamines.

CONCLUSION: -In all five articles, it was evident that Methamphetamine had a detrimental effect on the oral cavity; in terms of presentations like meth mouth, rampant dental caries, Xerostomia, bruxism, as well as poor gingival and periodontal health.

KEYWORDS:- Methamphetamine, oral cavity, dental caries, meth mouth, periodontitis, meth mouth

INTRODUCTION

Methamphetamine (MA) is a potent recreational drug that causes stimulation of the central nervous system. It is colloquially called crystal meth, ice, glass, tweak, gak, tina, chalk, crank and speed. It is consumed by either smoking, snorting, injecting or swallowing.

Nagayoshi Nagai, a Japanese chemist, working in Germany, discovered Ephedrine in 1887, the active chemical in a commonly used shrub in Chinese traditional medicine called Ephedra [1]. In 1919, Akira Ogata blended Ephedrine with red phosphorus to create Methamphetamine. This was released to a British Pharmaceutical company and marketed as a drug for treating sinus congestion, asthma and depression [2].

"Meth" as a drug was popularized during World War II among German Luftwaffe pilots and soldiers to help them stay more alert and keep their spirits up. It was marketed by a German pharmaceutical company Temmler under the brand name "Pervitin". Japanese Kamikaze pilots received high doses of Pervitin before suicide flight missions and, Japanese factory workers used it to work for longer hours[3].
The two most common forms in which MA is found are; a crystalline powder and a shiny, glass-like form known as “crystal meth”; which is also sold in the form of pills. A less common form is a wax-like, viscid oil called meth base. Its colour is usually white or translucent; but can also be yellow, brown, orange or pink, depending on how it is made and what it is cut with. Pure meth is completely translucent and odourless.[4]

MA facilitates the release of catecholamine, noradrenaline, dopamine and serotonin, from the nerve terminals of the brain and inhibits their uptake. This causes an increase in synaptic concentration of these neurotransmitters and results in increased stimulation of postsynaptic receptors. [4]

Methamphetamine abuse can be condensed into three categories. Occasional or low-intensity use, where MA pills are ingested, or powder form is inhaled to achieve “highs” or weight loss; Uncontrolled use, where MA is injected or smoked to achieve rapid, intense effects, triggering essentially psychological addiction; and High-intensity use, causing Psychological and physical addiction, demanding higher doses.[8]

Low to moderate doses (5–30 mg) cause symptoms like; arousal, positive mood, cardiac stimulation and acute improvement in cognitive domains such as awareness and psychomotor coordination.[5]

Typically illicit users consume doses equal to or greater than 50mg, which can produce psychosis. Its hypertensive effect can lead to several acute and chronic cardiovascular complications. In addition, constant use may induce neurotoxicity, associated with prolonged psychiatric symptoms, cognitive impairment and increases the chance to develop Parkinson's disease.[6]

Based on case reports, signs of overdose include agitation, dilated pupils, tachycardia, hypertension and increased respiratory rate, shivering, dyspnoea, chest pain, hyperpyrexia, cardiac failure, hepatic failure and renal failure.[9] This stage is accompanied by skin hyperesthesia and tactile hallucinations, which resemble the feeling of "insects under the skin". The addict presents with psychosis, insomnia, persecution mania and bad hygiene.[8]

However, the effects of this drug on the oral cavity is still unclear in the existing works of literature. Hence, this systematic review was conducted to comprehensively analyze this drug's reaction on oral health status.

METHODS AND METHODOLOGY
OBJECTIVE: To study the effect of Methamphetamine on the Oral cavity

SEARCH WORDS: Specific keywords used for each electronic database can be found in Table 1. A systematic computerized search was performed on electronic databases such a PubMed, Cochrane, Google Scholar, Science Direct, Wiley online library, Ovid Medline and LILACS. A total of 220 articles were collected, and these articles were scrutinized based on the inclusion, exclusion criteria, out of which Five relevant articles were chosen for this comprehensive analysis, contains the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart indicating the number of articles obtained and scrutinized.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>DATABASES</th>
<th>SEARCH TERMS</th>
<th>ARTICLES FOUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GOOGLE SCHOLAR</td>
<td>Methamphetamine abuse AND oral cavity AND meth mouth AND ulcers AND decay AND periodontitis AND discolouration</td>
<td>54</td>
</tr>
<tr>
<td>2</td>
<td>PUBMED</td>
<td>Methamphetamine abuse AND oral cavity AND meth mouth</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>OVID</td>
<td>Methamphetamine abuse AND oral cavity AND meth mouth</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>SCIENCE DIRECT</td>
<td>Methamphetamine abuse AND oral cavity AND meth mouth</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>LILACS</td>
<td>Methamphetamine abuse AND oral cavity</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>WILEY</td>
<td>Methamphetamine abuse AND oral cavity AND meth mouth AND decay</td>
<td>48</td>
</tr>
<tr>
<td>7</td>
<td>COCHRANE</td>
<td>Methamphetamine abuse AND oral cavity</td>
<td>0</td>
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INCLUSION CRITERIA: The articles included in this review were selected based on the following criteria:
1. The articles that studied the appearance of oral symptoms with Methamphetamine use.
2. Articles published in English
3. Full-text articles
4. Clinical trials

EXCLUSION CRITERIA: The articles excluded from this review were based on the following criteria:
1. Articles where multiple drugs were studied
2. Articles where Methamphetamine was not the focus of the study
3. Articles published in other languages
4. Articles where only abstracts were available
5. Unrelated articles
6. Review articles
7. Case reports
8. Editorials
TABLE 2:-

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>AUTHOR NAME, JOURNAL NAME AND YEAR</th>
<th>STUDY DESIGN</th>
<th>SAMPLE SIZE AND MATERIALS USED</th>
<th>METHODOLOGY</th>
<th>RESULT</th>
<th>OUTCOME</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Tao Ye et. al., 2018 BMC Oral Health</td>
<td>Cross-sectional</td>
<td>Sample size:- 162 former meth users Groups:- o Participants were divided into two groups based on age(≤ or &gt;33)</td>
<td>Data collection involved o Standardized Questionnaire o Tools for assessment:- o DMFT o CPI</td>
<td>The mean DT, MT, FT and DMFT scores in the former meth abuse group were 2.72 ± 2.78, 3.07 ± 3.94, 0.33 ± 1.03 and Both the prevalence and severity of dental caries in meth abusers was higher than in the general population.</td>
<td></td>
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<tr>
<td>2</td>
<td>Niklas Rommel 2015 Clinical Oral Investigations</td>
<td>Case-control</td>
<td>Sample Size:-100 crystal meth (CM) users</td>
<td>For the optimal comparability of data and verification of the study methods,</td>
<td>The mean DT, MT and DMFT scores in the drug-addicted population were all higher than in the corresponding epidemiological data.</td>
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<td>All participants of the CM group</td>
<td>The higher mean of the DMF-T index in the CM group with 12.3 teeth</td>
<td>The significantly higher DT and slightly lower FT scores in the former meth abusers indicated poor maintenance of oral health.</td>
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<td>The DT, DMFT and CPI scores in those who had abused meth for longer than four years was higher than those with a shorter abuse history</td>
<td>A high mean CPI was found, &amp; the prevalence of gingival bleeding, periodontal pockets in former meth abusers was higher.</td>
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<tr>
<td></td>
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<td></td>
<td>The DT score in those who brushed their teeth more than twice a day were significantly lower than those who brushed less frequently</td>
<td>Found a significantly higher dental caries, gingivitis and periodontitis</td>
<td></td>
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</table>

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had undergone withdrawal therapy

- For the control group, the matched-pair criteria were defined as gender and age (+/-1a) and were randomly selected from among the hospitalized patients.

The control group included 100 participants, who were matched one for each CM user.

- Tools of assessment:
  - DMFT & DMFS
  - BOP Index
  - PSI
  - Specific intra-oral plaque staining indices (Mira-2-Ton-Tablets, Hager Werken, Duisburg, Germany)

- Examination of all participants was divided into three parts. At each examination appointment, 10 CM users, on average, were examined.
  - First, caries prevalence was carried out using DMF-T & DMF-S indices. Active carious lesions per tooth (D-T) and per surface (D-S) were documented separately.
  - Second, bleeding on probing index (BOP) was used to detect potential gingival inflammatory processes. Each tooth was probed mesially and distally, and the index was calculated by the number of bleeding spots divided by all measured spots. PSI was used to detect periodontal health status.
  - Third, evaluation of individual oral hygiene by using specific intraoral plaque-staining indices.

- BOP index and PSI show a higher risk for gingivitis and periodontitis in cases of chronic meth use.

CM users than the control group of the same age and gender.

- Higher DMF-T, DMF-S index, and more active caries were found in regard to the D-T and D-S indices within the CM group.

- However, few cases of symptoms of Meth mouth syndrome, including rampant caries located at labial and proximal surfaces, were found.

- Poor oral hygiene was
<table>
<thead>
<tr>
<th>Sample size: - 100 Meth users</th>
<th>Control group including 100 matched-pair control participants, one for each meth user.</th>
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<tbody>
<tr>
<td>Sialometry method:</td>
<td>First, the test persons were screened for dry mouth from chronic meth consumption. Then, saliva flow rates and total saliva production in ml. within 5 min were taken using the sialometry method. Following this, individual saliva buffer capacities were tested by CRT buffer test, the principle of which included determination of the pH of the saliva.</td>
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<tr>
<td>Syringe</td>
<td>Secondly, potential trismus and bruxism were evaluated in connection with meth use. To assess trismus, the subjects were asked to open their mouth at maximum angle. For evaluation of bruxism, the following criteria were checked: 1. tooth attrition in tablets &amp; approximal space plaque index (API) was calculated. Oral hygiene was tested by the same examiner for all study participants.</td>
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<tr>
<td>Paraffin wax</td>
<td>The total saliva quantity was significantly lower in the meth users than in the control group (p &lt; 0.001).</td>
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<td>CRT Buffer test:</td>
<td>The median total saliva quantity of the meth group was 1.8 ml (SD ± 1.2), whereas, in the control group, the average volume was 4.1 ml (SD ± 2.7) of total saliva.</td>
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<td>pH Indicator sticks</td>
<td>Among the meth group, the buffer capacity (BC) of saliva was significantly lower (p &lt; 0.001). 9 % had high buffer capacity (pH above 6), 11 % medium-high (pH from 6–5.5) and 43 % medium buffer capacity (pH from 5.5–4.5); 30 % of meth users showed low-medium (pH from 4.5–4) and 7 % low buffer capacity (pH below 4).</td>
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<td>Maximum mouth opening:</td>
<td>In the control group, 55 % revealed high, 25 % medium-</td>
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<td>Wooden spatula</td>
<td>In cases of chronic MA abuse, the sympathomimetic effects of meth are extremely damaging to the stomatognathic system.</td>
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<td>Ruler</td>
<td>Lower saliva rate and significantly greater signs of bruxism within the meth group compared to the same-age and same-gender group with no history of Methamphetamine use.</td>
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In addition, chronic meth use showed a detrimental effect on saliva buffer capacity. Salivary flow averaged only 0.36 ml/min among 100 chronic MA users. The majority of all MA users experienced dry mouth from the beginning of MA abuse.

In addition, bruxism symptoms were found in a large number of patients (81 %) with a significant...
<table>
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<tr>
<th>4</th>
<th>Mukherjee et al. 2018 Quality of Life Research</th>
<th>Cross-sectional</th>
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<tr>
<td>Sample size: 545 Meth users</td>
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<td>minimum age of 18 years, should have used meth in the past 30 days</td>
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<td>Groups:</td>
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<td>o Participants were grouped into four age categories initially: less than 30 years, 30 to &lt; 45 years, 45 to &lt; 60 years, and 60 years &amp; over.</td>
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<td>Data was collected using the snowball sampling approach.</td>
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<td>OHRQOL (Oral Health-Related Quality of Life)</td>
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<td>Users were categorized as 'light' and 'moderate/heavy' users based on their frequency of use in the past 30 days.</td>
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<td>They also categorized them based on the route of administration. If participants used meth in any way other than smoking, their</td>
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<td>difference compared to the control group (p &gt; 0.001).</td>
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<td>78% of users had root caries affecting 3/&lt; teeth and severe periodontitis in 21.1% of the participants.</td>
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<td>59.5% of the participants reported painful aching in the mouth, avoidance of particular foods (56.5%), discomfort while eating (63.5%), and feeling embarrassed (60.7%) in the last 12 months.</td>
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<td>33.2% of users reported</td>
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<td>Meth users have poorer OHRQOL than the general population.</td>
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<tr>
<td>Affected sense of taste was found to be significantly associated with increased frequency of MA use and route of administration.</td>
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<tr>
<td>The continued presence of meth was more likely to aggravate Xerostomia and reduce salivary functions, which results in</td>
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route of administration was considered to be 'other.'
- The median split method was used to dichotomize the exposure of interest.
- Clinical dental status was evaluated using derived dichotomous variables (yes/no) based on the presence or absence of three dental conditions: anterior caries in a minimum of five teeth, surfaces, root caries in a minimum of 3 teeth, and severe periodontitis; which was measured following the CDC/AAP recommendation.
- The presence of any painful aching or sores/irritation in the mouth in the past 30 days were also analyzed.
- Users aged 45< were more likely to report dysgeusia and because of dental problems.
- Having anterior caries in 5< teeth surfaces, root caries in 3< teeth, and Tooth pain/mouth sores were significantly associated with unfavourable responses to all 7 OHRQOL indicators.

| 5 | Hegazi et al. 2020 Journal of Public Health Dentistry | Sample Size:- 8762 respondents (ages 30-64 years) between 2009-2014 NHANES (National Health and Nutrition Examination Survey) data | The teeth with untreated dental caries were scored from 0 to 28, and the data were dichotomized as 0 or ≥ 1 tooth with untreated dental caries.
* Any periodontitis was based on the definitions from the CDC and AAP, which included any participant diagnosed with mild, severe periodontal disease.
* The number of teeth with untreated dental caries was from 0 to 28, and the data were dichotomized as 0 or ≥ 1 tooth with untreated dental caries.
* The presence of any painful aching or sores/irritation in the mouth in the past 30 days were also analyzed.

24.0 % of adults in the three NHANES data sets had untreated dental caries, and 38.6 % had some form of periodontitis, with 7.7 % having severe periodontitis.
* At the time of the survey, current users had the highest prevalence of untreated dental caries, periodontitis, and severe periodontitis.

Results highlight the association of meth use on two major oral health diseases, specifically dental caries and periodontitis.
* Current and ever-established MA users have a higher risk of untreated dental caries and missing teeth than former and non-users.
* Former users were more likely to have...
missing teeth was assessed as count data.

- The prevalence of untreated dental caries was 1.23 times greater among established users compared to never users.
- Concerning any periodontitis, current users had a 1.31 greater prevalence compared to never users.
- Current MA users had a mean number of untreated dental caries 2.24 times higher when compared to those who had never used meth (95% CI: 1.28–3.88).
- The mean number of carious teeth and missing teeth was also significantly lower among those with more than a high school education [mean ratio: 0.59 (95% CI: 0.46–0.76) and mean ratio: 0.60 (95% CI: 0.52–0.69), respectively] compared to those with less than high school education.

periodontitis, as well as have more missing teeth compared to non-users.
- Meth users had significantly more missing teeth on average than non-users.

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**RESULTS**

The search yielded 220 articles, out of which 164 were screened and assessed independently. Among these articles, five were included and studied (Table 2).
DISCUSSION
In this systematic review, 220 articles were screened from various search engine databases. Five articles were selected for this study. The selection was based on the criteria of whether the effect of the oral cavity was studied in the given research. In our study, out of the five articles, 4 were cross-sectional study designs, while 1 was a case-control study. The exclusion was then done based on the relevance to the topic of study.

In all the studies, Methamphetamine use considered for analysis was found to have a deleterious effect on the oral cavity[8][9][10][11][12].

In the Cross-sectional studies conducted by Ye et al. in 2018 and Rommel et al. in 2015, the relation between meth usage and effect on the tooth as well as the presence of periodontal diseases was checked. The effect was observed to be poor in both, and this finding was statistically significant[8][9]. These findings are analogous to the propensity score analysis conducted by V. Shetty et. al.[13].

The findings of the studies mentioned above were synonymous with the Cross-sectional study conducted by Hegazi et al., using the NHANES data between the years 2009-14. In addition to the findings of greater prevalence of Dental caries and periodontitis in the meth users, it was observed that MA consumption by dual routes (orally and/or through injection) was associated with higher odds of severe periodontitis than only oral.[11]

These findings coincide with the findings of a case report by Turkyilmaz, where the symptomatic presentation of the above-mentioned findings was noticed only after the usage of the drug in the patient.[14].

In the Cross-sectional study by Rommel et al. in 2016, it was observed that the majority of the meth users experienced dry mouth(72%) and clenching(68%). Temporomandibular joint pain was reported by almost half of the users (47 %). In terms of salivary flow and Symptoms of bruxism, it was found that there was a reduction in the salivary flow and symptoms of bruxism were more prominent. These findings were found to be statistically significant. However, trismus symptoms comparing the two groups did not show much variation and were not statistically insignificant.[12].

These findings can also be substantiated by the findings given in the study conducted by Donaldson et al.[15].

The Cross-sectional study conducted by Mukherjee et al. revealed the impact of MA use on oral health-related quality of life (OHRQOL). Meth users had poorer OHRQOL than the general population. Affected sense of taste was found to be significantly associated with increased frequency of MA use, as well as with route of administration. It was also seen that the continued presence of meth was more likely to aggravate Xerostomia, thus reduced salivary functions, which results in Dysgeusia[13]. These findings coincide with the results in the Cross-sectional study done by Rommel et. al.[10].

CONCLUSION
It is evident from this systematic review that Methamphetamine usage causes symptoms like Xerostomia (dry mouth), dental caries, bruxism, oral sores and loss of teeth. These all can be defined under an umbrella term of "meth mouth". Symptom severity depends on the frequency and mode of consumption of the drug. We can conclude that Methamphetamine has a definite deleterious effect on the oral cavity; hence awareness among the general public and practitioners must be given to ensure that the drug is used judiciously with preventive measures aimed at the maintenance of a qualitative life.

REFERENCES


