Cannabis: A joint problem for patients and the dental profession

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VERIFIABLE CPD PAPER

IN BRIEF

- Improves the understanding of how cannabis produces its psychoactive effects on users.
- Improves awareness of the public health issues surrounding cannabis use and new psychoactive substances.
- Enhances knowledge on the effects of cannabis on oral health using the available evidence.
- Provide suggestions on how such a habit can be uncovered and discussed.

GENERAL

Cannabis is one of the most commonly abused drugs in the UK. The debate about its legality has grown in recent times but the health implication of cannabis use is an issue of today. It is a drug commonly described as being 'soft' but its use has profound effects on many of the body's systems, including the oral cavity. This is of particular importance to the dental clinician. This paper aims to discuss the oral implications of cannabis use and provide advice on ways in which dental professionals can approach this sensitive topic and provide support.

INTRODUCTION

Cannabis is a plant-derived drug that has been used extensively worldwide since 500 AD and is one of the most commonly abused drugs across the globe.[1] It has been reported that approximately 147 million people (2.5%) worldwide use cannabis.

In England and Wales the most commonly used illegal drug is cannabis.[2] It is classified as a class B drug. Recent statistics show that approximately 6.7% of adults aged 16 to 59 used cannabis in 2014/2015, whereas 16.3% of young adults aged 16 to 24 used cannabis in the same period. Even though there has been a steady decline from 2006-2015, cannabis still appears to be a favoured drug amongst young adults aged 16 to 24.[2]

Cannabis is referred to by many different names but is commonly known as marijuana, hashish and hash oil. Its historic and current use extends from medicinal, recreational and religious purposes.[3] It is derived from a plant called *Cannabis sativa*, which is grown in varying climates but usually indoors. The drug itself is extracted through drying and pressing of the plant.[4]

There are many different preparation methods for cannabis, the most common being in the form of dried leaves and flower, which is referred to as marijuana. Marijuana is usually smoked in hand constructed cigarettes, known as 'joints'. It can also be smoked through a water pipe or vaporiser. Alternatively, the dried leaves and flowers are added to food and consumed to elicit intoxication.[4] Hashish, on the other hand, is formed into small light brown to black blocks, which consist of the resin extract from the flower head.[5] Hash oil, a more concentrated liquid is derived from hashish and is less commonly used.

DELTA-9-TETRAHYDROCANNABINOL (THC)

Cannabis contains a total of 66 cannabinoids of which, delta-9-tetrahydrocannabinol (THC) has been identified to be the most potent. This is also mainly responsible for eliciting the psychoactive effects.[6]

THC has a mimicry action similar to a few endogenous compounds namely, N-arachidonylethanolamide (anandamide) and 2-arachidonoylglycerol (2-AG).[7] Therefore, THC has a natural affinity for specific receptors found within the endocannabinoid system of the human body.

There are two types of cannabinoid receptors, CB1 and CB2 on which THC interacts to produce its effect. They are found in various locations but CB1 receptors are densely populated in the brain, whereas CB2 receptors are found in larger numbers on immune cells and other tissues such as the gastrointestinal tract.[8]

The concentration of THC, within a given preparation of cannabis varies considerably.[9] The table below shows the average concentration of THC in three different preparations of cannabis.[10] It is clear that hashish oil, on average, contains six times as much THC than marijuana (Table 1).

ROUTE OF ADMINISTRATION

Cannabis is most commonly smoked in 'joints'; this rapidly administers the cannabinoid THC.[6] During the smoking process, approximately 50% of the available THC is inhaled whilst the remainder is lost as heat or smoke.[3] The effects of THC are apparent within minutes and usually diminish after 2-3 hours.[11] After the experienced effects THC remains present within adipose tissue for approximately 30 days while it is slowly released back into the body.[11]

Alternatively, cannabinoids in cannabis can be inhaled through water pipes and vaporisers. Vaporisers have become a growing trend and questions have been raised as to whether its use can be a less harmful mode of intoxication. Many vaporisers

Table 1 The average concentration of THC on three different preparations of cannabis

Cannabis form	Concentration (%)
Marijuana	9.6
Hashish	14.8
Hashish oil	66.4

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Table 2 The difference between tobacco and cannabis
Cannabis joints are usually smoked for a longer period of time than tobacco.[4]
Cannabis joints are usually smoked to a shorter joint length, which results in a greater number of toxins entering the mouth.[4]
Cannabis has a higher combustion temperature compared to tobacco.[4]
There is greater carboxyhaemoglobin concentration and tar retention in lower airway in cannabis smokers.[4]
Tobacco found in cigarettes is regulated. Whereas, cannabis is a non-regulated substance.
Tobacco is usually smoked more frequently than cannabis due to the shorter half life of nicotine.[4]

work via the passage of hot air through the dried cannabis thus causing the active components such as THC to essentially vaporise and become inhaled.[3] Despite limited studies having been conducted on these forms of inhalation techniques, recent studies have found that vaporisers were shown to reduce toxins compared with cannabis 'joint smoking'.[12] Conversely, other studies have found that there may be some detrimental effects of vaporising cannabis such as a significant production of neurotoxic ammonia.[12]

The ingestion of cannabis with foods is another route of administration, but the onset of the psychoactive effects are usually delayed by 1-3 hours.[1] This is primarily due to the longer absorption process via the gastrointestinal tract. Therefore, the onset time is highly unpredictable and the duration of action has been found to be considerably prolonged.[5,13]

NEW PSYCHOACTIVE SUBSTANCES

A growing concern for many is the emerging trend of new psychoactive substances (NPS) also referred to as 'legal highs', 'designer drugs' and 'club drugs'. These substances are not regulated and may appear safe due to the loosely attached term 'legal' but a number of these drugs have been found to be controlled substances.[14]

These synthetic psychoactive drugs have many similarities in their chemical structure, but not identical, to the drug they attempt to mimic. Therefore, they aim to produce a similar effect on the user. NPS' can be defined to 'stimulate or depress the CNS, or cause a state of dependence, have a comparable level of potential harm to internationally controlled drugs; and are newly available rather than newly invented'.[15]

Synthetic cannabinoids are intentionally modified variants of the cannabinoids found in cannabis. They are sprayed onto plant material and have previously been marketed as 'K2' and 'Spice'. The compounds interact with the same CB1 and CB2 receptors that THC interacts with but some of these substances are much more potent than THC and their effects on the body are hugely unpredictable.[16]

The manipulation of compounds to avoid the law has created a situation which poses new and rapidly changing challenges for the Department of Health and other sectors within the UK. The acute and chronic psychological and general effects of these NPS are unclear and strategies to tackle this growing problem are being reviewed.

GENERAL EFFECTS OF CANNABIS USE

Cannabis use affects multiple bodily systems, some more profoundly such as the respiratory, cardiovascular and the central nervous system. Its effects vary considerably between individuals, and also depend on the preparation and the mode of intoxication.[17]

Cardiovascular system

The THC found in cannabis has shown to consistently increase the heart rate, during the initial period of cannabis use, through the inhibition of vagal stimulation via interactions with neurotransmitters such as acetylecholine.[3,17] In contrast, bradycardia may be induced in some regular cannabis users further emphasising the complex effect of THC on the body.[17]

Respiratory system

Cannabis use, like tobacco smoking, has a significant impact on the respiratory system. There have been studies which describe the similarities in carcinogenic chemicals between cannabis and tobacoo.[18] However, there are many differences, some of which are shown in (Table 2).

ORAL IMPACT OF CANNABIS USE

The combined use of cannabis and tobacco, which is common amongst users, poses challenges for researchers who are interested in identifying the effects of cannabis alone. Using the available evidence the effects of cannabis on oral health will be discussed.

DRY MOUTH AND CARIES

Saliva is commonly known to protect the underlying mucosa from frictional damage. It is also an excellent buffering system involved in protecting the oral cavity, especially the teeth, from dental diseases such as caries.

A study carried out by Schulz-Katterback[10] aimed to assess the implications of cannabis use and the risk of developing dental caries. A sample size of 85 participants were used and divided into two groups. The control group were tobacco smokers only and the test group used cannabis and tobacco. Each participant was asked a series of questions regarding their diet, attitudes and behaviour towards dental care. The results obtained showed that cannabis users brushed their teeth less frequently than the control group. In addition, the control group visited their dentist more regularly whereas only 21% in the test group visited their dentist annually.

This study also established that cannabis users generally experienced dry mouth for approximately 1-6 hours after the use of cannabis. A study conducted by Darling *et al.*,[19] which aimed to determine the oral effects of cannabis found that dry mouth was experienced by 69.6% of its participants after smoking cannabis, compared to 18.6% of the cigarette smoking control group.[19] Moreover, the effects of dry mouth commenced immediately after the use of cannabis and the duration of the effects were variable between participants.

In contrast, Di Cugno *et al.*[20], found from their study of 198 young adult participants, that cannabis did cause a decrease in parotid saliva flow rate, but this was statistically insignificant as the cannabis using participants also used amphetamines and none used cannabis alone. Interestingly, the results did reveal that the pH of the test group was 6.90, whereas the pH of the control group was 7.51.[20] These findings would suggest that a person who uses cannabis has a reduced saliva buffering capacity than someone who does not use cannabis. The study provides some information about the effects of cannabis on the oral environment, but the reliability of the results can be questioned due to presence of confounding factors such as the concurrent use of other recreational drugs.

Through the effect of cannabis on leptin, an important hormone in regulating appetite, a cannabis user is frequently hungry immediately after cannabis consumption.[17] The combination of reduced saliva production, decrease in saliva pH and increased appetite can leave teeth vulnerable to attack from potentially cariogenic foods and drinks. A survey carried out by Schultz-Katterbach[10] of his participants regarding their diet found that 63% of those who felt hungry post cannabis use had consumed foods and drinks categorised as being sweet.

The study by Schulz-Katterbach[10] found that through a combination of poor oral

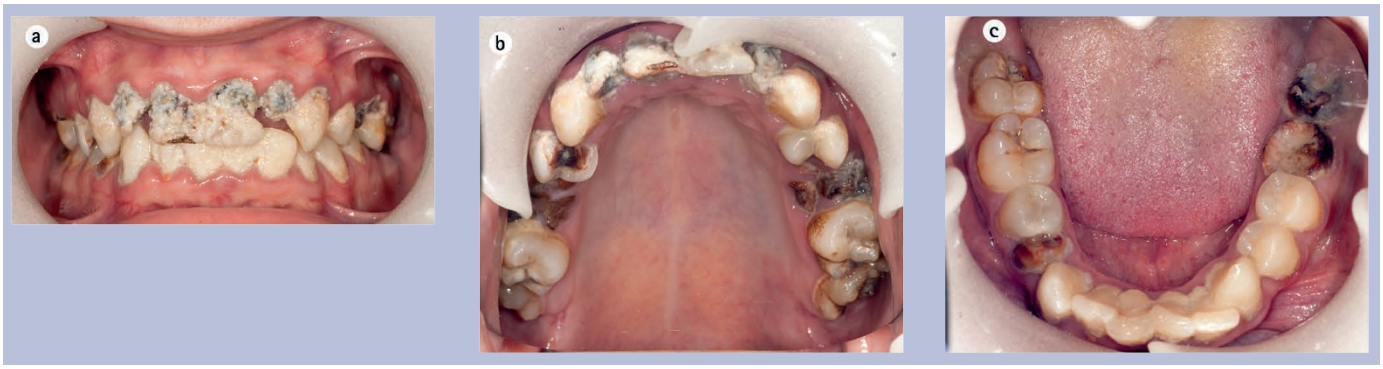

Fig. 1 The oral presentation of a 22-year-old patient who smoked six cannabis 'joints' a day for the last 8 years. Extensive caries present affecting multiple surfaces of numerous teeth. In addition, gross accumulation of plaque and calculus visible with inflammation of the gingivae

hygiene, less frequent dental visits and high cariogenic diets after cannabis use led to frequent identification of carious lesions, particularly, on smooth surfaces. The test group had approximately six times as many decayed surfaces compared to the control group.[10] Caries on smooth surfaces usually indicates poor plaque control as these surfaces are easily cleanable (Fig. 1).

A study carried out by Silverstein[21] supports Schulz-Katterbach[10] findings. The DMFT score of 77 subjects who had used recreational drugs was investigated. It is not surprising that 84% of the participants used cannabis. The DMFT score for cannabis users was 11.99, of which decayed teeth equated to 22% of the DMFT score. Similarly, Di Cugno *et al.*,[20] found the number of decayed teeth amongst cannabis users to be 2.5 times higher than that of controls, which made the overall DMFT index in their study statistically significant. Even though these studies have been conducted over 30 years ago, their findings highlight the oral health status of cannabis users. Further studies are required to look specifically at the DMFT value of cannabis users today, whilst limiting the number of confounding factors.

SOFT TISSUE DISEASES

Many drugs such as alcohol and tobacco have a direct effect on the soft tissues of the oral cavity and these are also commonly used by cannabis consumers.[22] However, cannabis has been found to also have a detrimental impact on the oral soft tissues.

Periodontal disease has been found to affect cannabis users. This could be closely associated with the xerostomic effect and the subsequent accumulation of plaque and calculus as a result of poor plaque control.[22] Saliva plays an important role in protecting the periodontal tissues. Its reduction caused by inhibitory mechanisms activated by cannabis can have damaging consequences. Gingival enlargement has also been seen to affect heavy cannabis users.[19] In addition, Darling *et al.*[19] also found 'painful fiery red gingivitis' and alveolar bone loss in heavy cannabis users.

It is clear that cannabis has a higher combustion temperature than tobacco and therefore, one would expect that a user is at greater risk of thermal injuries to the oral soft tissues. However, the evidence from the studies available has not conclusively stated that particular soft tissue injuries have been identified as a result of cannabis use. Nonetheless, chronic thermal injury could cause hyperkeratosis of the oral mucosa.[10] The frequency, duration and mode of intoxication of cannabis would possibly have an effect on the degree of thermal injury to the oral soft tissues.

Darling *et al.*[19] found the prevalence of leukoedema amongst participants was significantly higher in cannabis and tobacco smokers when compared to non-smokers. Leukoedema is a 'bilateral, diffuse, translucent greyish thickening, particularly of the buccal mucosa'.[23] It has been described as a variation of normal, which is more common in Afro-Caribbean individuals. The presence of leukoedema may be caused by many factors such as genetics, tobacco and cannabis smoking along with alcohol and other irritants.[19]

The association between candida and tobacco smoking has been known for many years. Therefore, a possible association between cannabis smoking and candida may also be present. A separate study conducted by Darling *et al.*[24] showed that there was an increased prevalence of candida amongst cannabis users. The immunosuppressive effect of THC via the CB2 receptors found on immune cells could potentially allow opportunistic infections, such as candida to proliferate and become clinically evident. A holistic approach must always be taken when assessing patients, as there are many other immunosuppressive drugs and diseases that could also cause conditions associated with candida. Darling *et al.*[24] described the following:

- Increased density of candida seen in cannabis users when compared to tobacco smokers and non-smokers
- A combination of poor denture hygiene, deficient nutritional intake and cannabis use can contribute to the manifestation of candida
- Certain candidal species can utilise components of cannabis such as hydrocarbons to produce energy, which can be used for reproduction.

CANNABIS AND ORAL CANCER

Cannabis, like tobacco, contains an array of carcinogens including 'phenols, nitrosamines, vinyl chloride and various polycyclic aromatic hydrocarbons'.[25] The quantity of tar inhaled and retained in the lower respiratory tract has been shown to be higher in cannabis smokers in comparison to tobacco smokers.[26] Another difference between tobacco smoke and cannabis smoke is that cannabis smoke contains 50% more of the carcinogenic hydrocarbons.[27] It is well known that there are many risk factors for oral cancer, some of which include the use of alcohol and tobacco. The combined use of both alcohol and tobacco significantly increases the risk of developing oral cancer. However, the role of cannabis in being a risk factor of oral cancer is unclear.

A case-controlled study conducted by Zhang *et al.*[28] found an increased risk of head and neck cancer amongst cannabis users. This had a dose dependent relationship even after adjusting for possible confounding factors. Similarly, a study carried out by Hashibe *et al.*[26] also found a positive dose dependent relationship between cannabis use and oral and laryngeal cancer. However, this relationship was no longer observed once confounding factors such as cigarette smoking were adjusted for. Caplan *et al.*[29] described two cases where both individuals who regularly smoked cannabis, but had no past history of cigarette smoking or alcohol drinking, were found to

have squamous cell carcinoma of the tongue. Dahlstrom *et al.*[30] conducted a study of 172 never smoker-never drinker (NSND) participants who were newly diagnosed with squamous cell carcinoma of the head and neck (SSCHN). Eleven percent of this group had regularly used 'non-cigarette tobacco or marijuana.' It was concluded that there was an increased identification of SSCHN of the oral tongue amongst NSND, but no single aetiological factor could be responsible for these findings.

In contrast, a study carried out by Rosenblatt *et al.*[31] found no association between cannabis use and oral cancer. In support, another two studies carried out by Llewellyn *et al.*,[32,33] which involved the analysis of 53 cases in one study and 116 cases in another, found there to be no increased risk of oral cancer amongst regular cannabis smokers. It is clear that the results of the different studies are conflicting and this could be due to differing methodology of their studies. Moreover, participants are more prone to under report the amount of cannabis used due to its illegal status.

The concurrent intake of alcohol, tobacco and possibly other social drugs makes it difficult to be certain if cannabis alone is a risk factor for oral cancer. In order to reach a firm conclusion, rigorous clinical trials with robust methods would be required. Hashibe *et al.*[26] outlines recommendations for future research which states that the amount of cannabis used by a participant should be clearly quantified, the mode of intoxication established and to conduct research projects in countries where cannabis is not illegal. This would allow more accurate and reliable results to be obtained. Uncertainty surrounding the possible link between cannabis use and oral cancer still remains, but a possible association should not be disregarded. Table 3 summarises the oral implications of cannabis use.

HOW CAN RECREATIONAL HABITS BE UNCOVERED?

As a health care professional it can be very challenging and daunting to discuss a patient's recreational habit. This is primarily due to the illegal nature of many recreational drugs and patients' reluctance to reveal their habits. It is in the patient's best interest that recreational habits such as cannabis use are uncovered and briefly discussed so that patients can be directed towards appropriate care and support.

There are no fixed criteria or guidance documents available which clearly state how one can approach the topic of cannabis use. However, it is clear that a set formulated approach will not prove successful with all patients and therefore flexibility is required.

In order to open an avenue for discussion, medical history forms can be adjusted, to contain a section where patients can simply tick a box if they have either never used, previously used or currently use recreational substances. Hashibe *et al.*[26] found that participants in their study were more susceptible to underreporting their cannabis use when asked face-to-face than if they were asked through a questionnaire. A well laid out questionnaire will appear general, standardised and not targeted specifically at certain patients. Some patients may not initially disclose any recreational substance use until they feel more confident in the dentist and able to trust them with the information. This exemplifies how important it is to be flexible in the approach when gathering information.

WHAT ADVICE CAN I GIVE ONCE A RECREATIONAL HABIT HAS BEEN UNCOVERED?

It is important as a dental professional to acknowledge in a non-judgemental manner, that a patient has disclosed sensitive information about their life regarding the use of a controlled substance. Patients should be made aware that all information provided and discussed will remain confidential and any information will only be shared out with the patient's informed consent. This would instil deeper trust in the patient as they may be more likely to be open about their habits.

The framework provided in section 7 in the *Delivering better oral health*[34] document regarding smoking and tobacco use, is an excellent structure which could be used with cannabis consumers. The format of; 'Ask, Advice and Act' could be used to give 'very brief advice' on the use of cannabis. It is crucial that patients are not immediately warned about the dangers of cannabis use as this could 'create a defensive reaction and raise anxiety levels.'[34] This could potentially create barriers between the dental clinician and the patient.

It is best to leave the discussion towards a dedicated period in the consultation where the patient can be educated on the effects of cannabis on oral health. During the 'very brief advice' period, it is essential that the patient's motivation to stop using cannabis is gauged and the subsequent advice tailored to their desire to quit. It is well known that habits are best broken and cessation achieved via appropriate support throughout the process. An engaging and motivated patient should be directed to their general medical practitioner, local community NHS Stop Smoking Services[35,36] and/or Talk to Frank.[37] The use of leaflets, which are available from Talk to Frank can be a very useful tool in conveying concise information to patients.

The patient should be educated on the importance of prevention of dental diseases through improved oral hygiene techniques and regimes, but also on the benefits of fluoride. Furthermore, the patient's diet should be investigated and appropriate advice should be given in reducing the amount of sugary foods and drinks and to consider healthier alternative substitutes.

ONCE A PATIENT HAS BEEN DIRECTED, WHAT CAN THEY EXPECT?

There is an abundance of useful information available on NHS Stop Smoking[35,36] and Talk to Frank[37] websites regarding many drugs including cannabis. These websites, which are regularly updated, provide a great tool for both patients and the dental professional. Talk to Frank is a dedicated organisation that is available to be contacted at any time and provide advice. Patients who use recreational drugs should be strongly advised to visit their website.

In brief, Talk to Frank advises cannabis users who are attempting to give up, to identify reasons and trigger factors for using cannabis. Once these have been established,

Table 3 A summary of the oral implications of cannabis use

Oral implications of cannabis use	Associated implications
Dry mouth (Xerostomia)- short term	Increased risk of caries. Increased risk of periodontal disease. Increased risk of frictional injuries. Halitosis.
Thermal injury	Hyperkeratinisation due to higher combustion temperature of cannabis.
Leukoedema	Normal variation. Clinically detectable due to multifactorial reasons: genetics, alcohol, tobacco and cannabis use.
Candidal infection	Increased risk of candidal infection – poor oral hygiene/denture hygiene – nutritional deficiency.
Oral cancer	Cannabis contains similar carcinogens to tobacco. Possibility of a link with cannabis use. However more evidence required.

diversions should be put in place to avoid the trigger factors. An action plan should be devised which states a clear stop date. In addition, a strong supportive network of family, friends and professionals at Talk to Frank should be present and available to provide encouragement at all times. The journey is understandably difficult and withdrawal symptoms may be experienced such as irritation, anxiety, anger, craving for cannabis and sleeplessness. However, these symptoms will eventually subside. During this period it is advised that nutritious meals are regularly eaten and exercise is carried out to help minimise the potential withdrawal symptoms.

CONCLUSION

Cannabis is a very common recreational drug used around the world. The challenges faced by healthcare professionals are increasing with the growing use of NPS'. There is evidence to show that cannabis has a negative effect on oral health, however, further studies are required with reduced confounding factors in order to show more accurate findings.

As dental professionals we are likely to encounter cannabis users frequently throughout our working career. Therefore, one must be prepared and confident in discussing the effects of cannabis use on oral and general health and be able to either provide or direct towards a holistic support programme which addresses the social habits.

The complexity of unravelling the specific effects of cannabis on an individual is extremely challenging, as discussed earlier, but it can be said with certainty that cannabis use does have an impact on oral health. This paper has aimed to enhance the dental professional's armamentarium with regards to knowledge on cannabis and its general and oral effects, along with ways to uncover a recreational habit and give advice to patients.

Since this manuscript was accepted for publication, the Psychoactive Substances Act has been introduced into UK legislation on 26th May 2016. This makes it illegal to produce, supply and possess psychoactive substances.

1. Versteeg P A, Slot D E, Velden U, Weijden G A. Effects of cannabis usage on the oral environment: a review. *Int J Dent Hygiene* 2008; **6:** 315–320.
2. Home Office. *Drug misuse: Findings from the 2014/15 Crime Survey for England and Wales.* 2015. Available online at https://www.gov.uk/government/statistics/drug-misuse-findings-from-the-2014-to-2015-csew (accessed March 2016).
3. Borgelt L M, Franson K L, Nussbaum A M, Wang G S. The pharmacologic and clinical effects of medical cannabis. *Pharmacotherapy* 2013; **33:** 195–209.
4. Gates P, Jaffe A, Copeland J. Cannabis smoking and respiratory health: Consideration of the literature. *Respirology* 2014; **3:** 655–662.
5. Cho C M, Hirsch R, Johnstone S. General and oral health implications of cannabis use. *Aust Dent J* 2005; **50:** 70–74.
6. Gambhir R, Brar P, Anand S, Ranhawa A, Kakar H. Oral health aspects of cannabis use. *IndJ Multidis Dent* 2012; **2:** 507–511.
7. Devane W A, Hanus L, Breuer A *et al.* Isolation and structure of a brain constituent that binds to the cannabinoid receptor. *Science* 1992; **258:** 1946–1949.
8. Pertwee R G, Howlett A C, Abood M E *et al.* International union of basic and Clinical Pharmacology. LXXIX. Cannbinoid receptors and their ligands: beyond CB1 and CB2. *Pharmacol Rev* 2010; **62:** 588–631.
9. Pacifici R, Zuccaro P, Pichini S *et al.* Modulation of the immune system in cannabis users. *J Am Med Assoc* 2003; **289:** 1929–1931.
10. Schulz-Katterbach MS. Cannabis and caries-does regular cannabis use increase the risk of caries in cigarette smokers? *Zurick Open Repos Arch* 2009; **119:** 576–583.
11. Ashton CH. Pharmacology and effects of cannabis: a brief review. *Br J Psychiatry* 2001; **178:** 101–106.
12. Doblin R. The MAPS/California NORMAL marijuana waterpipe/vaporiser study. Newsl. Multidiscip. Assoc. Psychedelic. Stud 1999; **5:** 19–22.
13. Agurell S, Halldin M, Lindgren J E *et al.* Pharmacokinetics and metabolism of delta 1-tetrahydrocannabinol and other cannabinoids with emphasis on man. *Pharmacol Rev* 1986; **38:** 21–43.
14. Home Office. *Annual report on the Home Office forensic early warning system.* 2015. Available online at https://www.gov.uk/government/publications/forensic-early-warning-system-fews-annual-report (accessed March 2016).
15. Home Office. *New Psychoactive Substances Review: Report of the expert panel.* 2014. Available online at www.gov.uk/government/publications/new-psychoactive-substances-review-report-of-the-expert-panel (accessed March 2016).
16. National Institute on Drug Abuse. *DrugFacts: Synthetic Cannabinoids.* 2015. Available online at www.drugabuse.gov/publications/drugfacts/synthetic-cannabinoids (accessed March 2016).
17. Grotenherman F. Pharmacology of cannabinoids. *Neuroendocrinology* 2004; **25:** 14–22.
18. Moir D, Rickert W, Levasseur G *et al.* A comparison of mainstream and sidestream marijuana and tobacco cigarette smoke produced under two machine smoking conditions. *Chem Res Toxicol* 2008; **4:** 494–502.
19. Darling M R, Arendorf T M. Effects of cannabis smoking on oral soft tissues. *Community Dent Oral Epidemiol* 1993; **21:** 78–81.
20. Di Cugno F, Perec C J, Tocci A A. Salivary Secretion and dental caries experience in drug addicts. *Archs oral Biol* 1981; **26:** 363–367.
21. Silverstein S J. Relation between social drug use/abuse and dental disease in California U S A. *Community Dent Oral Epidemiol* 1973; **1:** 89–93.
22. Rees TD. Oral effects of drug abuse. Criti Rev Oral Biol Med1992; **3:** 163–184.
23. Cawson, R, Odell E. Benign chronic white mucosal lesions. *In* Cawson's essentials of oral pathology and oral medicine. 8th ed. pp 252. Philadelphia: Elsevier, 2008.
24. Darling M R, Arendorf T M, Coldrey N A. Effects of cannabis use on oral candidal carriage. *J Oral Pathol Med* 1990; **19:** 319–321.
25. Hoffman D, Brunneman D, Gori G, Wynder E. On the carcinogenicity of marijuana smoke. Recent Adv. *Phytochem* 1975; **4:** 63–81.
26. Hashibe M, Straif K, Tashkin D P, Morgenstern H, Greenland S, Zhang Z F. Epidemiologic review of marijuana use and cancer risk. *Alcohol* 2005; **35:** 265–275.
27. Hoffman D, Brunnemann K D, Gori G B, Wynder E L. On the carcinogenicity of marijuana smoke. *In* Runeckles V C (ed.) *Recent Advances in Phytochemistry* 1st ed. pp 63–68. New York: Plenum, 1975.
28. Zhang Z F, Morgenstern H, Spitz M *et al.* Marijuana use and increased risk of squamous cell carcinoma of the head and neck. *Cancer Epidemiol Biomarkers Prev* 1999; **8:** 1071–1078.
29. Caplan G A, Brigham B A. Marijuana smoking and carcinoma of the tongue. Is there an association? *Cancer* 1990; **66:** 1005–1006.
30. Dahlstrom K R, Little J A, Zafereo M E, Lung M, Wei Q, Sturgis E M. Squamous cell carcinoma of the head and neck in never smoker-never drinkers: A descriptive epidemiologic study. *Head Neck* 2008; **30:** 75–84.
31. Rosenblatt K A, Daling J R, Chen C, Sherman K J, Schwartz S M. Marijuana use and risk of oral squamous cell carcinoma. *Cancer Res* 2004; **64:** 4059–4054.
32. Llewellyn C D, Linklater K, Bell J, Johnson N W, Warnakulasuriya K A A S. Squamous cell carcinoma of the oral cavity in patients aged 45 years and under: a descriptive analysis of 116 cases diagnosed in the South East of England from 1990 to 1997. *Oral Oncology* 2003; **39:** 106–144.
33. Llewellyn C D, Linklater K, Bell J, Johnson N W, Warnakulasuriya S. An analysis of risk factors for oral cancer in young people: a case-control study. *Oral Oncology* 2004; **40:** 304–313.
34. Public Health England. *Delivering Better Oral Health: an evidence-based toolkit for prevention.* 3rd Edition. 2014. Available online at www.gov.uk/government/uploads/system/uploads/attachment_data/file/367563/DBOHv32014OCTMainDocument_3.pdf (accessed February 2016).
35. NHS choices. *Cannabis the facts.* 2014. Available online at http://www.nhs.uk/livewell/drugs/pages/cannabis-facts.aspx (accessed January 2016).
36. NHS. *Local Stop Smoking Services.* 2015. Available online at http://www.nhs.uk/smokefree/help-and-advice/local-support-services-helplines (accessed January 2016).
37. Talktofrank. Cannabis. 2009. Available online at http://www.talktofrank.com/drug/cannabis (accessed March 2016).