IN BRIEF

- Oral cancer is an important disease that is easily identified in a dental practice setting.
- This study shows that GDPs can easily detect relevant lesions using a simple systematic mucosal examination, with little disruption to a normal practice routine.
- The prevalence of relevant lesions and of risk habits among patients who attend general dental practices appears to be representative of the general population.
- The data suggest that opportunistic screening in a general dental practice setting, particularly if high risk groups can be targeted, might be a realistic option.

Opportunistic screening for oral cancer and precancer in general dental practice: results of a demonstration study

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Objectives To demonstrate the feasibility of opportunistic oral cancer and precancer screening in general dental practice and to determine the prevalence of relevant lesions and risk habits in a population of general dental practice attenders.

Design A prospective demonstration study, recruiting patients opportunistically.

Setting General dental practices.

Methods Eighteen general dental practitioners took part in this study. Each attended training sessions to be advised of the study protocol and the criteria of a positive and negative screen. Patients over the age of 35 years were prospectively and opportunistically recruited. Each patient was asked to complete a health questionnaire concerning age, gender, ethnicity, smoking and drinking habits. The dentist then examined the soft tissues and recorded the presence or absence of lesions independently on a second form. The forms were collated and data were analysed to determine prevalence of lesions and associations with risk habits.

Results Data on 2,265 patients were available for analysis. Oral lesions were detected in 319 patients (14.1%). Ninety-four patients (4.2%) had lesions considered to be either malignant or potentially malignant. There was a significant association between positive lesions and male gender (IRR 1.86, 95% CI 1.22-2.82), heavy smoking (males: IRR 3.68, 95% CI 2.10-6.43: female; IRR 3.58, 95% CI 1.35–9.50) and heavy alcohol use in males (IRR 2.98, 95% CI 1.06–3.47).

Conclusions The results suggest that patients attending general dental practices are representative of the general population both in terms of lesion prevalence and high risk habits such as smoking and drinking. This supports the view that opportunistic screening in a general dental practice setting may be a realistic alternative to population screening. Further research is needed to determine the cost effectiveness of this approach and to investigate the value of targeting high risk groups within this population. General dental practice is ideal for the evaluation of such systems prior to extending these studies to other healthcare settings.

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Oral cancer is a major global health problem and is the sixth most common cancer worldwide[1] and according to the International Agency for Research on Cancer (IARC) there were over 266,000 new cases of intra-oral cancer in the year 2000, with the majority (64%) occurring in males.[2] The world age-standardised incidence rate (the number of new cases per 100,000 per year) was 6.42 for males and 3.27 for females. The estimated number of deaths from mouth cancer in the year 2000 was nearly 128,000.

In England the latest data show 2,870 new cases of oral cancer in 1998[3] with an overall incidence of 7.6 for males and 3.6 for females. In recent years the number of cases has increased steadily, for example from 2,377 in 1995, and from a total for England and Wales of less than 2,000 per year in 1985.[4] This trend is reflected in increasing incidence and mortality rates that have particularly affected younger males in the 35–64 age group.[5]

For the United Kingdom as a whole, the IARC estimated that registrations of oral cancer for the year 2000 were 4,459 of which 2,923 occurred in males and 1,536 in females. The estimated number of deaths from oral cancer in the UK was 1,334 for males and 717 for females.[2] The figures for incidence and deaths do not fully indicate the magnitude of the burden of the disease in the population. Another indicator is prevalence. The UK 5-year prevalence (number of people alive with oral cancer diagnosed in the preceding 5-years) in the year 2000 was believed to be 12,740 (8,186 male, 4,554 female). Thus at any time nearly 13,000 people in the UK are living under the shadow of oral cancer.[2]

In addition to increasing incidence, mortality remains high with over 50% of patients dying of their disease. Most studies have shown no improvement in survival for decades,[5] but a recent, more detailed examination of the data suggests small improvements for most oral sites, which are most evident in more affluent socio-economic groups.[6] These figures are despite the fact that the oral cavity is easily accessible and about half the population receives regular oral examinations during routine dental treat-

ment. Unfortunately, there is a lack of public awareness of the disease and patients are slow to seek attention.[7–9] The simple fact is that over 60% of all patients present with late lesions when the prognosis is already poor and metastatic spread has already occurred.[6,10,11]

Although primary prevention in the form of advice and education about risk factors is important, this is largely ineffectual as evidenced by increased tobacco use in the UK despite knowledge of the risks, and the lack of evidence of effectiveness of mass education programmes in improving oral health.[12] There is clearly a large gap between knowledge and behaviour change.

One way forward is to improve early detection of oral cancer, either by case finding or by organised screening programmes. The rationale for this is that oral cancer may be preceded by a clinically detectable potentially malignant lesion (leukoplakia or erythroplakia) or that it may begin as a small, localised, often asymptomatic lesion in the early part of its natural history.[11] If detected when small, these lesions can be treated thus avoiding the notoriously high mortality and morbidity associated with this cancer. It is unlikely however that population screening for oral cancer will ever be instituted. The UK Working Group on screening for oral cancer and precancer reported in 1993 that there was insufficient evidence to support population screening and laid out an agenda for further research.[13]

Recent pilot studies of oral cancer screening programmes using a simple oral examination showed that dental screeners in a hospital, medical practice or industrial setting could detect relevant lesions with a sensitivity and specificity equivalent to that achieved in other screening programmes.[14,15] However the compliance for screening following a postal invitation was only about 25%,[16] leading the researchers to conclude that such a programme may not be cost effective. A viable alternative might be to carry out screening opportunistically, especially if high-risk groups could be targeted. Using the data from the pilot programmes[14,15] an artificial neural network was trained which was shown to be able to detect relevant oral lesions with a sensitivity of 0.80 and specificity of 0.77.[17] By means of simulation modelling techniques it was subsequently shown that this computer system could preselect high-risk individuals and identify 80% of all lesions by screening only 25% of the population.[18,19]

Initially, the most obvious place to evaluate opportunistic screening or case finding is in a general dental practice environment. At present however, there are no data on the prevalence of lesions, or of high risk habits in a population of dental attenders, and there have been no attempts to evaluate oral cancer screening in primary dental care.

The purpose of the present investigation was to establish a demonstration study of opportunistic oral cancer screening in a dental primary care environment and to determine the characteristics of routine general dental practice attenders in terms of the prevalence of relevant habits and of malignant or potentially malignant lesions.

MATERIALS AND METHODS

For the purposes of this study, oral cancer was defined as squamous cell carcinoma of the lip (ICD-9, 140), tongue (ICD-9, 141), gum, floor of mouth, 'mouth', oropharynx (ICD-9, 143-146), hypopharynx and 'other sites' (ICD-9 148, 149).[4,20] (The equivalent codes in the current ICD-10 are: C00 – C06, C09, C10 and C14.) The setting for this study was general dental practice. Eighteen general dental practitioners took part, 16 were located in Greater London, one in Nottingham and one in Aldershot. The practices predominantly offered a mix of National Health Service and private dentistry. Each dentist attended two training sessions to standardize criteria for the identification of lesions and to receive instruction on the protocol of the study. In the context of screening for potentially malignant or malignant lesions, the dentists were advised of the criteria for a positive and negative screen. A positive screen was defined as the presence of a white patch or a red patch, or of an ulcer of longer than 2 weeks duration.[14] These basic criteria were modified by defining a number of well known clinical entities which might have these appearances but should be included as positive or negative lesions.[21] For example, ulcers and white lesions with an obvious traumatic aetiology and recurrent ulcers (aphthae) were regarded as negative, whereas lichen planus, actinic keratosis and submucous fibrosis were defined as positive.

Table 1 Characteristics of the patient population

Factor	Description	Number	(%)
Gender	Male	1,078	(47.6)
	Female	1,187	(52.4)
Age group	35-39	236	(10.4)
	40-44	290	(12.8)
	45-49	323	(14.3)
	50-54	319	(14.1)
	55-59	286	(12.6)
	60-64	229	(10.1)
	65-69	214	(9.4)
	70-74	164	(7.2)
	75-79	109	(4.8)
	80-84	73	(3.2)
	85-89	15	(0.7)
	90+	7	(0.3)
Ethnic group	White	1,892	(83.5)
	Black	173	(7.6)
	South Asian	120	(5.3)
	Chinese	31	(1.4)
	Other	49	(2.2)

Patients aged over 35 were prospectively and opportunistically recruited. It was not possible to prescribe set criteria for the method of recruitment and each dentist selected the most appropriate method to suit their practice routine. Some recruited sequentially, while others recruited randomly or on fixed days per week. The aim was for each dentist to attempt to recruit around 200 patients into the study. Each patient was first asked to complete a questionnaire concerning his or her age, gender, ethnicity, and smoking and drinking habits. This was normally completed in the waiting room under the guidance of a practice nurse or receptionist.

Before commencing routine treatment the dentist then recorded the presence or absence of lesions independently on a second form. The site and appearance of all lesions, whether positive or negative, were recorded. The nature of each lesion or a diagnosis, when obvious, was also entered on the form. The dentists were blinded to the results of the questionnaire at the time of examination. The two forms were later collated and sent in batches to the research team at the Eastman Dental Institute.

Patients with lesions were referred as appropriate for secondary care, according to the normal protocols of each practice. There was no attempt, in this study, to record the results of secondary care.

Data were analysed using the *STATA* statistical software package (Version 5.0, Stata Corporation, Texas, USA). Incidence rate ratios (relative risk for having a positive lesion) were calculated for for smoking and alcohol consumption using Poisson regression adjusted for the age of the patient.

RESULTS

The 18 participating practitioners returned a total of 2,342 forms (minimum 5, maximum 423). One-hundred-and-twelve forms (4.8%) were excluded due to either the patient being less than 35-years-old (77 forms) or as a result of illogical combinations of responses (35 forms). The remaining forms, relating to 2,265 patients, were evaluated. Tables 1 and 2 summarise the character-

Table 2 Self-reported behavioural characteristics of the patients

Factor	Description	Definition	Number	(%)
Smoking	Heavy	20 or more cigarettes/day	179	(7.9)
	Moderate	up to 19 cigarettes/day	474	(20.9)
	Non	never smoked or not within last 10 years	1,612	(71.2)
Alcohol	Heavy	Units/week: > 20 males, >14 females	50	(2.2)
	Moderate	Units/week: 5-20 males, 5-14 females	323	(14.3)
	Non or light	Up to 4 units/week)	1,892	(83.5)
Dental attendance	'Regular'	(within the last year)	1,962	(86.6)
	'Irregular'	(not within the last year)	303	(13.4)

Table 3 Lesions detected

		Number	(%)
Positive lesions	Carcinoma	2	(0.1)
	White patch	45	(2.0)
	Red patch	11	(0.5)
	Lichen planus	31	(1.4)
	Persistent ulcer	2	(0.1)
	Submucous fibrosis	1	(< 0.1)
	Actinic keratosis	2	(0.1)
	Total positive	94	(4.2)
Negative lesions	Non-specific or traumatic ulcers	39	(1.7)
	Frictional/traumatic keratosis	30	(1.3)
	Fibrous overgrowths	28	(1.2)
	Candida/denture stomatitis	14	(0.6)
	Smokers keratosis (palate)	12	(0.5)
	Aphthous ulcers	10	(0.4)
	Amalgam tattoo	9	(0.4)
	'Haemangioma'	7	(0.3)
	Angular cheilitis	5	(0.2)
	Abscess/sinus	5	(0.2)
	Mucoceles	4	(0.2)
	Geographic tongue	3	(0.1)
	Naevus	3	(0.1)
	Miscellaneous	56	(2.5)
	Total negative	225	(9.9)
	Total lesions	319	(14.1)

istics of the sample of patients examined. Table 1 indicates the physical characteristics of the sample and Table 2 indicates their self-reported smoking and drinking habits.

Oral lesions were detected in 319 patients, giving an overall lesion prevalence of 14.1% (Table 3). Ninety-four patients (4.2%) had lesions that were considered to be either malignant or potentially malignant (positive lesions). This included two squamous cell carcinomas one of which had developed from submucous fibrosis. Table 4 gives the distribution of positive lesions according to gender, ethnicity, smoking habits, and alcohol consumption. The number of positive lesions occurring in the different ethnic groups was too small to submit to formal statistical analysis.

The associations between smoking and alcohol consumption and the prevalence of positive lesions are indicated in Table 5. The strengths of the associations were quantified by the incidence rate ratio (IRR), which is a measure of relative risk adjusted for the patient's age. The results are stratified by gender since there is evidence that males have nearly twice the risk of a positive lesion compared with females and that the risk factors may not have exactly the same effect for both males and females. For both genders, heavy smoking significantly increased the risk of a positive lesion by over 350%. No significant relationship could be detected between moderate smoking and the risk of having a positive lesion for either males or females. The effect of alcohol consumption differed between men and women. For men, there was a significant association between alcohol and risk. Moderate alcohol consumption was associated with nearly twice the risk of having a positive lesion, while heavy drinking was associated with nearly three times the risk when compared with non/light drinkers. No significant relationships between alcohol consumption and positive lesion prevalence were detected for women.

DISCUSSION

This was a prospective study carried out opportunistically in typical general practice settings. The purpose was to determine the prevalence of relevant lesions and habits in a dental practice population and therefore there was no specific targeting of high-risk groups; indeed doing so would have negated the purpose of this study.

The prevalence of mucosal lesions detected in this study was 14.1%, which is similar to other studies. However comparisons are difficult, because there have been few similar studies in non-institutionalised populations and the criterion for lesions varies markedly. For example, in a recent study in Germany, Reichart[22] reported that 66.2% of 35–74-year-olds had mucosal lesions, but this included Fordyce spots (23.7%) and patients with a history of aphthous ulceration (18.3%). In Spain, Martinez-Diaz and Garcia-Pola[23] reported a prevalence of 58.75% among subjects attending a dental school for periodontal or prosthodontic treatment. However this included pigmentation (24.6%) and 'linea alba' (10.7%). In another study of a random sample of Sicilian men mucosal lesions were found in 81% of the group,[24] but this included over 50% with 'coated tongue'. Nevertheless the prevalence of leukoplakia in this group was 13.8%, which was ascribed to the high numbers who used alcohol and tobacco. It should be noted that in the present study variants of normal were not included as mucosal lesions, thus the prevalence of 'furry tongue', Fordyce spots, varices and 'leukoedema' have not been recorded.

Table 4 Distribution of positive lesions

Factor	Description	Number	%
Gender	Male	59	(5.5)
	Female	35	(2.9)
Ethnic group	White	87	(4.6)
	Black	1	(0.6)
	South Asian	4	(3.3)
	Chinese	2	(6.5)
	Other	0	(0.0)
Smoking	Heavy	25	(14.0)
	Moderate	16	(3.4)
	None	53	(3.3)
Alcohol consumption	Heavy	5	(10.0)
	Moderate	23	(7.1)
	Non or light	66	(3.5)

Table 5 Factors associated with the presence of a positive lesion

Factor	Description	IRR	(95% CI)	*P*
Gender	Male	1.86	(1.22, 2.82)	0.004
	Female	1*		
Smoking in females	Heavy	3.58	(1.35, 9.50)	0.010
	Moderate	1.89	(0.87, 4.13)	0.110
	Non	1*		
Smoking in males	Heavy	3.68	(2.10, 6.43)	< 0.001
	Moderate	0.57	(0.25, 1.29)	0.179
	Non	1*		
Alcohol in females	Heavy	1.84	(0.25, 13.48)	0.548
	Moderate	2.63	(0.38, 4.08)	0.713
	Non or light	1*		
Alcohol in males	Heavy	2.98	(1.06, 8.38)	0.039
	Moderate	1.93	(1.12, 3.47)	0.019
	Non or light	1*		

* = Baseline group for each comparison

In a more comparative, population based, study of subjects over 35 in the USA, Bouquot[25] analysed data from 23,616 oral examinations and reported 3,783 mucosal lesions in 2,824 people – giving an overall prevalence of 10.3% of subjects. This included 1% with Fordyce spots. In this same study the prevalence of white keratotic lesions was 3.4% and of leukoplakia 2.9%.[26]

In the present study, positive lesions were recorded in 4.2% of subjects. This is more than previously found in a general medical practice environment (2.2%) or among patients of a dental hospital (3.0%),[14] but is slightly less than that recorded among subjects screened in a company headquarters (5.5%).[15] Since the age groups in these studies were similar, the reasons for these differences are not clear. In the previous studies, subjects were invited to have an oral examination, either directly or by letter and it is possible that those who abused alcohol, or were heavy smokers refused. In the company headquarters however, and in the present study, recruitment was opportunistic. It is possible therefore that a prevalence of 4–5% is more representative of the population as a whole.

There have been a number of studies which have determined the prevalence of potentially malignant and malignant lesions and some of these are summarised in Table 6.[14,15,22,24,25,27–47] Although overt cancers were recorded, the most common relevant lesion was 'leukoplakia' and therefore most of these studies may be regarded as demonstrating the prevalence of this entity. However leukoplakia is poorly defined and, similar to the current study, most can be regarded as recording mainly the prevalence of persistent white or keratotic lesions. The setting of these studies varies, but overall, most show a prevalence of between 1 and 6%, which is similar to that found in this study and our other UK studies.[14,15] Most studies are of specific age groups, but those which show a high prevalence have usually been conducted in high risk groups and have been carried out with some element of targeting, either in countries where the prevalence of oral cancer and precancer is high,[28,30,31,33,40] in high-risk populations such as heavy smokers and drinkers or betel quid users,[24,36,42,47] as part of multiphasic screening such as those attending lung cancer clinics[46] or in convenience populations like the institutionalised elderly, forces personnel and attenders of hospital outpatients clinics or medical practices.[14,15,32,39]

An informative UK study was that carried out by Pearson *et al.*[47] among the Bangladeshi population of East London. This showed a prevalence of leukoplakia of 25%, with a positive association with betel quid or paan chewing. This highlights the potential dangers of extrapolating data from one population to another without taking account of the nature of our multicultural society.

The proportions of alcohol and tobacco users were also similar to those previously reported. In our previous study 8% were heavy smokers (current study; 7.9%, Table 2) and 3% were heavy drinkers (current study; 2.2%). Overall, 29% were smokers and 16.5% were moderate or heavy drinkers. Data from the ONS omnibus surveys conducted in 2000 and 2001 show that 26% of the population are current smokers[48] and 34% of men and 26% of women in the 45–64 year age group drink more than three or four days per week.[49]

The effects of smoking and alcohol consumption and the likelihood of having a positive lesion or condition were also clearly seen and are similar to our previous study where heavy smoking showed a significant relationship.[14] In the current study, heavy smokers were more likely to have a positive lesion by a factor of 3.58 for females and 3.68 for males. This study also showed that men who drank heavily were about three times more likely to have a positive lesion.

Because of the relatively low prevalence of the disease, and a lack of adequate knowledge of the natural history, it is generally agreed that mass population screening for oral cancer and precancer may not be cost-effective and cannot be recommended.[13,50,51] Opportunistic screening, undertaken when patients attend a healthcare professional for some other purpose, may however be beneficial,[13,20,50] especially if high risk groups can easily be identified and targeted for primary preventive advice and a mucosal examination.[13,19] Opportunistic case finding is already an important component of a routine dental check-up, but further research is needed to determine the prevalence in the general population as well as in different subpopulations and ethnic groups, so that appropriate high risk groups can be targeted.[52,53]

The results of this study suggest that the population attending general dental practices, who are self selecting and therefore thought to be not representative, is representative of the general population both in terms of lesion prevalence and high risk habits. This suggests that opportunistic screening in a general dental practice setting may be a realistic option. Careful targeting of high risk individuals within this group may make this more cost effective and on-going studies are investigating methods of pre-selection and targeting within primary care environments. It is recognized that, at any one time, only 50% of the population are registered with a dentist, but general dental practice is an ideal environment to evaluate these systems prior to investigating applications in other healthcare settings.

Table 6 Representative screening and prevalence studies for oral cancer and precancer from 1971 to 2002

Authors [reference]		Year	Country	Population/setting	Age	*n*	Cancers	Precancers	%+ve
Ross and Gross	[27]	1971	USA	Gen. population	35+	12,868	1	339	2.6
Mehta *et al.*	[28]	1972	India	Gen. population	15+	101,761	11	1,628	1.6
Axell	[29]	1976	Sweden	Gen. population	15+	20,333	1	732	3.6
Warnakulasuriya	[30]	1984	Sri Lanka	Gen. population	20+	29,295	4	1,230	4.2
Mehta *et al.*	[31]	1986	India	Gen. population	35+	39,331	20	511	1.4
Bouqout	[25]	1986	USA	Gen. population	10-90	23,616	22	682	3
Viglid	[32]	1987	Denmark	Institutionalised elderly	65+	285	2	19	7.4
Warnakulasuriya	[33]	1991	Sri Lanka	Gen. population	20+	57,124	20	3,541	6.2
Ikeda *et al.*	[34]	1991	Japan	Gen. population	18-63	3,131	0	77	2.5
Banoczy and Rigo	[35]	1991	Hungary	Lung clinic screening	19-60	7,820	1	104	1.3
Talamini *et al.*	[36]	1994	Italy	High risk referrals	35+	627	10	55	14.9
Downer *et al.*	[15]	1995	UK	Company HQ	40+	292	0	17	5.8
Jullien *et al.*	[14]	1995	UK	Dental hosp,	40+	1,042	1	21	3.0
Jullien *et al.*	[14]	1995	UK	Medical practice	40+	985	1	31	2.2
Ikeda *et al*	[37]	1995	Japan	Gen. population	60+	802	0	38	4.7
Ikeda *et al.*	[38]	1995	Cambodia	Gen. population	15+	1,319	1	41	3.2
Field *et al.*	[39]	1995	UK	Gen. population	<20->69	1,947	1?	4	0.2
Mathew *et al.*	[40]	1997	India	Gen. population	35-64	2,069	1	212	10.2
Prout *et al.*	[41]	1997	USA	Tobacco users	40+	4,611	1	590	12.8
Szabo *et al.*	[42]	1997	Hungary	Homeless, alcoholics	Not given	300	8	42	16.7
Zain *et al.*	[43]	1997	Malaysia	Gen. population	25+	11,707	5	165	1.5
Reichart	[22]	2000	Germany	Aging Germans	35-74	2,022	0	55	2.7
Sankaranarayanan	[44]	2000	India	Gen. population	35+	114,601	63	1,310	12
Kovac-Kovacic	[45]	2000	Slovenia	Perio patients	25-75	1,609	0	106	6.6
Campisi, Margiotta	[24]	2001	Sicily	Random male	40+	118	1	4	13.9
Dombi *et al.*	[46]	2001	Hungary	Lung clinic screening	18+	5,034	0	188	3.7
Pearson *et al.*	[47]	2001	UK	Bangladeshi	40+	137	0	28	20.4
Current study		2002	UK	Dental practices	35+	2,265	2	92	4.2

There are few studies worldwide where oral cancer screening has been thoroughly evaluated with appropriate endpoints. Two studies however, from Cuba and India, provide encouraging results with evidence that morbidity and mortality can be reduced.[44,54] Santana *et al.*[54] report a study from Cuba where an oral cancer case finding programme was carried out between 1983 and 1990, this was shown to be effective in reducing the number of oral cancers presenting at a late stage. Patients presenting with stage I lesions rose from 22.8% to 48.2% and stage II, III, and IV fell from 77.25 to 51.8%. In the Indian study,[44] one of the largest in the world, the intervention group showed 72.3% of early stage lesions compared with 12.5% in the control group. Furthermore, this study was able to demonstrate a reduction in mortality, with 3 year fatalities of 14.9% in the intervention group compared with 56.3% in the control group. Neoplasms discovered when small, could result in substantial cost savings for the Health Service. Early diagnosis of lesions that are smaller than 2.0 cm (Stage I) have a good prognosis[10,11] and since 20% of oral cancer patients get another cancer within a 5-year period[55,56] regular screening in a general practice setting could also detect second, metachronous lesions while they are small.

SUMMARY AND CONCLUSIONS

The prevalence of mucosal lesions in a population attending typical general dental practices was 14.1%, with 4.2% of lesions being regarded as malignant or potentially malignant. This, and the proportions of smokers and drinkers are comparable with data for the general population as a whole and to other prevalence studies in similar settings. The results suggest that dental attendees are quite representative of the general population and support the view that opportunistic oral cancer screening in general dental practice may be a realistic option. Further studies are needed to determine the potential of targeting high risk groups within these populations, to evaluate similar approaches in other healthcare settings and to determine the cost-effectiveness.

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