



The awareness and attitudes of oral disease specialists, pathologists, and maxillofacial surgeons in oral exfoliative cytology in Kerman, Iran

Maryam Alsadat Hashemipour^{1,2*}, Parsa Behnam^{1,2}, Fatemeh Ghasemzadeh^{1,2}

¹Department of Oral Medicine, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran

²Dental and Oral Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran. Kerman Social Determinants on Oral Health Research Center, Kerman University of Medical Sciences, Kerman, Iran

*Corresponding Author: Maryam Alsadat Hashemipour, Email: m.s.hashemipour@gmail.com

Abstract

Background: The present work examines the awareness and attitudes of specialists in oral diseases, pathology, and maxillofacial surgery in 2022 regarding oral exfoliative cytology.

Methods: This study was an analytical and cross-sectional research. The statistical population of the present study included Iranian oral disease specialists, pathologists, and maxillofacial surgeons. A researcher-made questionnaire was given to the specialists by a senior (final-year) student. The results were analyzed using the chi-square test and *t*-test using SPSS 18 software. The significance level in data analysis was $P < 0.05$.

Results: A total of 192 questionnaires were completed in the study; the study revealed that only 18 participants used the exfoliative cytology technique. Moreover, 62% of people had a positive attitude towards the application and performance of cytology. There was a significant relationship between positive attitude, field of study, graduation year, and age. The mean awareness scores in men and women were 32.38 ± 4.21 and 34.42 ± 3.89 , respectively. The participants had a high awareness and positive attitude towards this technique. Additionally, the mean awareness scores of oral specialists, surgeons, and pathologists were 33.12 ± 4.23 , 33.65 ± 5.12 , and 33.45 ± 5.34 , respectively.

Conclusion: The study revealed that only 9.4 percent of participants used the exfoliative cytology technique. However, they were highly aware of and had a positive attitude to this technique.

Keywords: Awareness, Attitude, Exfoliative cytology, Dentistry

Citation: Hashemipour MA, Behnam P, Ghasemzadeh F. The awareness and attitudes of oral disease specialists, pathologists, and maxillofacial surgeons in oral exfoliative cytology in Kerman, Iran. *J Oral Health Oral Epidemiol.* 2024;13(2):61–66. doi: [10.34172/johoe.2301.1529](https://doi.org/10.34172/johoe.2301.1529)

Received: September 2, 2023, **Accepted:** January 30, 2024, **ePublished:** July 7, 2024

Introduction

“Biopsy” is a word with Greek roots, derived from the words βίος (bios), “life,” and ψις, “opinion.” The first biopsy was carried out by the Arab physician Abulcasis (1013–1107). He used a needle to take a sample of the patient’s goiter to test it. French dermatologist Ernest Besnier introduced the term biopsy to the medical society in 1879. A biopsy refers to taking a tissue sample. It is a diagnostic procedure often carried out by a surgeon, radiologist, cardiologist, and dentist who removes some body tissue and sends it to a histology lab for testing. In the histology or pathology lab, the pathologist studies the tissues under a microscope and diagnoses and reports any possible diseases in the tissue.¹

Sampling is suggested for many lesions, such as cancers, precancerous lesions, inflammatory lesions, and benign tumors, and its most prevalent use is to evaluate

and confirm cancerous lesions, such as oral cancers.² Although some authors advocate non-interventional approaches by general dentists, others recommend that general dentists prepare biopsies to help in the early diagnosis of oral cancer.^{3,4}

Timely diagnosis of a cancerous or precancerous lesion enhances the chances of survival and reduces mortality among those suffering from these conditions.^{5,6} Oral exfoliation has been a diagnostic tool for over 40 years. Exfoliative cytology examines cells by scraping tissue surfaces or collecting body fluids like saliva and sputum.⁷

In 1967, an editorial in the ADA Journal stated that exfoliative cytology should be a part of any oral examination for a disease where the clinician suspects even the slightest malignant lesion. Moreover, 9.2% of dentists have never used exfoliative cytology smears because of lack of knowledge and equipment.⁵⁻⁸



As no studies have been carried out on the views of Iranian dentists about this type of sampling, this study aimed to examine the attitudes and awareness of specialists in oral diseases, pathology, and maxillofacial surgery in 2022 regarding oral exfoliative cytology.

Methods

The study was a cross-sectional analytical research. The population consisted of Iranian oral specialists, pathologists, and maxillofacial surgeons. A researcher-made questionnaire with personal questions, such as age, graduation year, general questions, and questions on experts' opinions about sampling, was given to the specialists by a senior student, and they were asked to fill it out. The senior student participated in all specialized dental congresses held in Iran in 2022 in the three fields and distributed the questionnaires during the congresses. The purpose of the study was explained to each individual, and a questionnaire was provided to the individual if they were interested in participating.

Additionally, all the individuals were assured that the information in the questionnaire would remain confidential and would be examined only statistically. The questionnaire questions were designed by two dentists and one statistician, so five faculty experts confirmed the scientific validity of the questionnaire. Based on their opinions, the validity of the questionnaire's content was satisfactory. After editing and changing the order of items, the final questionnaire with 28 questions and demographic characteristics was prepared. The reliability of the questionnaire was optimal according to the Cronbach's alpha coefficient (0.75). Regarding the awareness questions, the correct answer was given a score of 2, the wrong ones zero, and "I do not know" was given 1 point. The awareness score ranged from zero to 48 points (0–16 = low awareness, 17–32 = average awareness, and above 32 = good awareness).

The attitude questions were measured on a Likert scale, and a score of 5 to zero was given to strongly agree, agree, have no opinion, disagree, and strongly disagree, respectively. The score range was between zero and 90 (0–45 = negative attitude and 45–90 = positive attitude). The results were analyzed using the *t*-test and chi-square test using SPSS 18. *P* values < 0.05 were considered significant in the data analysis.

Results

First, 210 questionnaires were distributed, of which 192 were examined (response rate = 91.4%). Of the respondents, 95 were male and 97 were female. There were 52 oral specialists, 91 oral and maxillofacial surgeons, and 49 pathologists (Table 1).

Only 18 participants used the exfoliative cytology technique in the present research; they mentioned lack of experience (15 people), lack of confidence in interpreting

Table 1. Demographic characteristics of the participants in the study

Characteristics		n	%
Gender	Male	95	49.4
	Female	97	50.5
Age	≤35	34	17.7
	>35	158	82.2
Graduation period	≤10	21	10.9
	10<	171	89
Degree	Oral diseases	52	27
	Pathology	49	25.5
	Oral and maxillofacial surgery	91	47.3
Workplace	Office	54	28.1
	Clinic	28	14.5
	Dental school	65	33.8
	Several places	45	23.4

the results (48 people), preferring biopsy to this method (100 people), and unfamiliarity with this method (19 people) as the reasons for not using the method.

The study indicated that about 81.25% (156 people) of the participants were familiar with the equipment to carry out this procedure (glass slide, cytology brush, and alcohol spray).

Table 2 shows the participants' answers to the attitude questions, with 62% of the respondents showing a positive attitude towards using cytology and performing sampling. There was a significant relationship between positive attitude, field of study, graduation year, and age. Pathologists had a more positive attitude compared with surgeons and oral disease specialists. Young people and those who had more recently graduated had a more positive attitude. However, there was no significant relationship between gender and positive attitude.

Table 3 demonstrates the participants' answers to the awareness questions. The mean awareness scores in men and women were 32.38 ± 4.21 and 34.42 ± 3.89 , respectively. Moreover, the mean awareness scores in oral disease specialists, surgeons, and pathologists were 33.12 ± 4.23 , 33.65 ± 5.12 , and 33.45 ± 5.34 , respectively.

The study indicated no significant relationships between awareness score, field of study, and gender. However, there was a significant relationship between graduation year, age, and awareness score (young people and those who had graduated more recently had higher awareness scores than older people and those who graduated a longer time ago).

Table 4 shows the mean, standard deviation, maximum, and minimum scores of awareness and attitude based on the specialized field.

Discussion

Evaluation of the awareness, attitude, and practice of oral health care staff about oral cancer is critical for

Table 2. Responses of the participants to attitude questions

Questions	Fully agree		Agree		I have no idea		Disagree		Fully disagree	
	No.	%	No.	%	No.	%	No.	%	No.	%
Timely diagnosis of cancer and precancerous lesions can reduce cancer mortality and disability.	190	98.9	2	1	0	0	0	0	0	0
Exfoliative cytology can be a powerful tool for early diagnosis of cancer.	79	41.1	32	16.6	34	17.7	24	12.5	23	11.9
Exfoliative cytology can be a powerful tool for early diagnosis of precancerous lesions.	79	41.1	32	16.6	34	17.7	24	12.5	23	11.9
Exfoliative cytology can be a powerful tool for early diagnosis of fungal infections.	44	22.9	34	17.7	54	28.1	50	26	20	10.4
Exfoliative cytology can be a powerful tool for early diagnosis of viral infections.	74	38.5	96	50	12	6.25	10	5.2	0	0
Because of the reliance on personal interpretation and the fact that sometimes very few abnormal cells can be detected in the smear, the use of oral exfoliative cytology in the office is less considered.	52	27	104	54.1	10	5.2	21	10.9	5	2.6
Studying exfoliative cytology of oral cells is a noninvasive method that patients will accept.	61	31.7	40	20.8	45	23.4	34	17.7	12	6.25
Using exfoliative cytology is limited, given its low sensitivity and specificity in diagnosing oral malignancy.	134	69.7	45	23.4	3	1.5	10	5.2	0	0
Exfoliative cytology is a simple, almost inexpensive, high-sensitivity, high-risk, cancer-free screening procedure that aids clinical examinations.	153	79.8	25	13	14	7.2	0	0	0	0
Taking the full thickness of the epithelium in exfoliative cytology is essential for the complete evaluation of the lesions.	145	75.5	45	23.4	2	1	0	0	0	0
Exfoliative cytology is used as an adjunct in the diagnosis of diabetes.	123	64	34	17.7	24	12.5	7	3.6	4	2
Exfoliative cytology is used in patients with titanium implants.	113	58.8	44	22.9	14	7.2	15	7.8	6	3.1
Exfoliative cytology is used as a diagnostic tool in patients with clinical signs of desquamative gingivitis.	78	40.6	56	29.1	46	23.9	12	6.2	0	0
Exfoliative cytology is a diagnostic tool for patients with irritable bowel syndrome.	53	27.6	45	23.4	21	10.9	45	23.4	28	14.5
Exfoliative cytology shows small specific tissue changes rather than cancer.	94	48.9	51	26.5	10	5.2	37	19.2	0	0
Exfoliative cytology is used as a diagnostic tool in HPV.	65	33.8	66	34.3	38	19.7	23	11.9	0	0
Exfoliative cytology does not indicate the development of invasion.	162	84.3	30	15.6	0	0	0	0	0	0
The reliability of this technique is limited.	123	64	54	28.1	15	7.8	0	0	0	0

several reasons. As oral cancer can be diagnosed early by examinations and diagnostic tools, dentists, as one of the health care groups, play a key role in advising patients on early diagnosis.⁹⁻¹⁴

One approach for the early diagnosis of oral cancer is using exfoliative cytology. Although the method has some errors, it is known as one of the simple and noninvasive techniques for diagnosing suspected dysplasia cases. Studying oral cell cytology is a noninvasive approach that is well-accepted by patients. It is thus an interesting option for early diagnosis of oral cancer, including epithelial cell deformity and squamous cell carcinoma. Nonetheless, its usage is limited due to its low sensitivity and specificity in diagnosing oral malignancy. In 1967, an editorial in the Journal of the American Dental Association indicated that exfoliative cytology has to be part of any oral examination of a disease where the clinician suspects even the slightest malignant lesion. The oral cytology technique training program has already started for many dentists in the United States and Europe, and oral exfoliation has been used as a diagnostic tool for more than 40 years.¹⁵

The study examined the awareness and practice of

oral disease specialists, pathologists, and maxillofacial surgeons regarding exfoliative cytology.

The study revealed that only 18 (9.3%) participants used the exfoliative cytology technique. The people mentioned reasons such as lack of experience, lack of confidence in interpreting the results, preferring biopsy to this method, and unfamiliarity with this method.

Movahedinia et al¹⁶ showed that students' knowledge and performance of oral medicine were very poor which is incompatible with other studies.^{17,18}

In Jairajpuri et al's study,¹⁹ 9.2% of dentists had not used exfoliative cytology smears because of the lack of awareness and equipment, which aligns with our study results. Moreover, by studying general dentists, Silva et al²⁰ showed that only 10.53% of general dentists had previous experience performing this procedure. In Shaila and colleagues' research,²¹ only 2% of the participants used the exfoliative cytology technique, and many thought the method was unsuitable for clinical practice.

The results indicated that 13.2% of the participants had taken a practical course on exfoliative cytology. Horowitz et al. stated that only 10% of all dentists had

Table 3. Participants' answers to the awareness questions

Which of the following statements about the cytology method is correct?	Right		Wrong		I have no idea	
	No.	%	No.	%	No.	%
Painless	188	97.9	4	2	0	0
No bleeding	192	100	0	0	0	0
Non-aggressive	188	97.9	4	2	0	0
Fast and easy	190	98.9	2	1	0	0
Economical	187	97.3	5	2.6	0	0
Requires minimal equipment	190	98.9	2	1	0	0
Easy medical technique for the dentist	190	98.9	2	1	0	0
Suitable for patients with systemic disease who have not had a biopsy	180	93.7	2	1	10	5.2
Prevents false negative biopsy results	143	74.4	49	25.5	0	0
Does not have the complications after biopsy.	192	100	0	0	0	0
Suitable for high-volume screening.	192	100	0	0	0	0
Ability to diagnose malignant lesions early.	156	81.2	36	18.7	0	0
Suitable for repetitive follow-ups	165	85.9	12	6.2	15	7.8
It is suitable for determining the appropriate location of biopsy in diffuse lesions.	178	92.7	14	7.2	0	0
It provides less information than histological slides.	189	98.4	3	1.5	0	0
Positive results are reliable, but negative results are not.	148	77	24	12.5	20	10.4
Suitable only for epithelial cells	164	85.4	28	14.5	0	0
It is sometimes used to assess connective tissue lesions.	67	34.8	113	58.8	12	0
It is only a complementary procedure, not an alternative to biopsy	190	98.9	2	1	0	0
Its interpretation requires an experienced and skilled pathologist.	190	98.9	2	1	0	0
Tumor grading is impossible.	192	100	0	0	0	0
It minimizes the trauma.	192	100	0	0	0	0

Table 4. Mean, standard deviation, minimum, and maximum score of awareness and attitudes of specialists by study field

Specialized field	Awareness				Attitudes			
	Mean	SD	Max.	Min.	Mean	SD	Max.	Min.
Oral diseases specialist	34.12	4.23	35	21	68.23	3.25	76	52
Maxillofacial pathology	33.45	5.34	34	18	76.45	5.12	80	51
Oral and Maxillofacial Surgery	33.65	5.12	36	22	69.27	4.67	79	55

performed a cytology procedure, and 96.9% of dental offices lacked the materials needed for exfoliative cytology.²² Furthermore, Airajpuri et al¹⁹ indicated that only 13 dentists participating in their study had used this method; only 12 were familiar with it and had received the necessary training.

Silva et al²⁰ reported that none of their participants had participated in oral disease specialty programs, which indicated no training in the area, according to the researchers. The difference with our study can be because Silva and colleagues' subjects²⁰ were general dentists. Nonetheless, Shaila et al²¹ showed that 44.5% of the dentists had received training. This shows the emphasis on this method in India, where oral cancer is very prevalent and even accounts for 50% of body cancers in some regions.

Moreover, 75.5% (145 people) of the participants in the present study were familiar with exfoliative cytology

sampling. In the research by Silva et al,²⁰ 98.68% claimed to be familiar with exfoliative cytology.

The present findings indicated that about 81.25% (156 people) of the participants were familiar with the necessary equipment to conduct this method (glass slide, cytology brush, and alcohol spray), which is in line with the results of Silva et al²⁰ and Shaila et al.²¹

Cytology brushes, wooden spatulas, metal spatulas, and cotton swabs are among the other equipment mentioned in studies as tools for collecting exfoliative cytology materials.²³⁻²⁹

Most reports in the papers are associated with wooden spatulas. However, using wooden spatulas causes the collected material to be insufficient because wood can absorb some of the sample and, therefore, reduce the quality of the smear.

Some scholars have stated that moistening a wooden spatula prevents the sampling area in the mouth from

drying out.²⁵ Using a cytology brush leads to a uniform distribution of cells on the slide compared to a wooden spatula, which results in better uniformity and cellularity of the smear compared to a metal spatula.²⁶

Moreover, 57.8% (111 people) of the participants argued that exfoliative cytology could be a powerful tool for early diagnosis of precancerous and cancerous lesions. Based on the findings by Silva et al,²⁰ about 50% of people agreed that exfoliative cytology should be used to diagnose leukoplakia.

According to studies, there are two reasons for this controversy: firstly, the diagnosis of leukoplakia is made by rejecting other differential diagnoses, and secondly, leukoplakia is a clinical concept that can appear with different tissues and molecular and genetic patterns.^{28,29} The use of exfoliative cytology in leukoplakia is still a matter under discussion as the lesion is keratotic and not injured, and its characteristics do not indicate the application of exfoliative cytology. However, exfoliative cytology can be used to select the best biopsy site for large leukoplakia lesions. Some scholars have advocated using exfoliative cytology in leukoplakia, arguing that signs of dysplasia and malignancy can be seen in the upper layers of the squamous epithelium (due to the migration of cells from the basal layer). Hence, the degree of nuclear abnormality in the surface layers can indicate the atypical total thickness of the epithelium. Other researchers have stated that this method is unsuitable for hyperkeratotic lesions as the collected cells may not be a suitable sample for evaluating exfoliative cytology.³⁰

The present study indicated that pathologists had a more positive attitude compared with surgeons and oral disease specialists, which is not in line with the findings of Silva et al,²⁰ who found a significant difference between those who underwent oral and implant surgery and those who underwent orthodontics. This difference is probably because of the deeper discussions of pathology and diagnosis in the oral surgery curriculum. The results indicated that more than 80% of those diagnosed with oral lesions and surgery are also aware of exfoliative cytology.

It was also found that the participants have a very good attitude and awareness of this method; the attitude score in the present study was higher than other studies,^{20-22,31} which is due to the study of three specialized disciplines of dentistry with more contact with mouth lesions.

Even though biopsy is the gold standard for diagnosing oral cancer, using adjuvant techniques like toluidine blue staining and cytology enhances our ability to distinguish between benign and dysplastic lesions and malignant changes. It helps to identify the areas of dysplasia invisible to the naked eye.

Oral exfoliative cytology is a relatively simple and noninvasive clinical technique that has the potential to be developed as a routine investigation for the screening of

diabetes mellitus (DM). It can be used chairside during routine dental examinations.³²

Conclusion

The study revealed that only 18 participants used the exfoliative cytology technique. Nonetheless, the participants had a high awareness and positive attitude toward this technique.

Acknowledgements

We are grateful to the Journal of Oral Health and Oral Epidemiology for their valuable assistance in editing and improving the manuscript text.

Authors' Contribution

Data curation: Parsa Behnam, Fatemeh Ghasemzadeh.

Writing—original draft: Maryam Alsadat Hashemipour.

Writing—review & editing: Maryam Alsadat Hashemipour.

Ethical Approval

This work was approved by the Vice Deputy of Research at Kerman University of Medical Sciences and the university Ethics Committee (Reg. No. 95000094, IR.KMU.REC.1395.390).

Funding

No funding.

References

1. Sandlin CW, Gu S, Xu J, Deshpande C, Feldman MD, Good MC. Epithelial cell size dysregulation in human lung adenocarcinoma. *PLoS One*. 2022;17(10):e0274091. doi: [10.1371/journal.pone.0274091](https://doi.org/10.1371/journal.pone.0274091).
2. Kejík Z, Kaplánek R, Dytrych P, Masařík M, Veselá K, Abramenko N, et al. Circulating tumour cells (CTCs) in NSCLC: from prognosis to therapy design. *Pharmaceutics*. 2021;13(11):1879. doi: [10.3390/pharmaceutics13111879](https://doi.org/10.3390/pharmaceutics13111879).
3. Aghili SS, Zare R, Jahangirnia A. Evaluation of paxillin expression in epithelial dysplasia, oral squamous cell carcinoma, lichen planus with and without dysplasia, and hyperkeratosis: a retrospective cross-sectional study. *Diagnostics (Basel)*. 2023;13(15):2476. doi: [10.3390/diagnostics13152476](https://doi.org/10.3390/diagnostics13152476).
4. Grimm M, Hoefert S, Krimmel M, Biegner T, Feyen O, Teriete P, et al. Monitoring carcinogenesis in a case of oral squamous cell carcinoma using a panel of new metabolic blood biomarkers as liquid biopsies. *Oral Maxillofac Surg*. 2016;20(3):295-302. doi: [10.1007/s10006-016-0549-2](https://doi.org/10.1007/s10006-016-0549-2).
5. Noh ST, Lee HS, Lim SJ, Kim SW, Chang HK, Oh J, et al. MAGE-A1-6 expression in patients with head and neck squamous cell carcinoma: impact on clinical patterns and oncologic outcomes. *Int J Clin Oncol*. 2016;21(5):875-82. doi: [10.1007/s10147-016-0989-6](https://doi.org/10.1007/s10147-016-0989-6).
6. Yang G, Wei L, Thong BK, Fu Y, Cheong IH, Kozlakidis Z, et al. A systematic review of oral biopsies, sample types, and detection techniques applied in relation to oral cancer detection. *BioTech (Basel)*. 2022;11(1):5. doi: [10.3390/biotech11010005](https://doi.org/10.3390/biotech11010005).
7. Singh V, Varma K, Bhargava M, Misra V, Singh M, Singh R. Evaluation of role of visual inspection using acetic acid (VIA) and exfoliative cytology in screening and early detection of oral premalignant lesions and oral cancer. *Asian Pac J Cancer Prev*. 2021;22(7):2273-8. doi: [10.31557/apjcp.2021.22.7.2273](https://doi.org/10.31557/apjcp.2021.22.7.2273).
8. Kaur M, Saxena S, Samantha YP, Chawla G, Yadav G.

- Usefulness of oral exfoliative cytology in dental practice. *J Oral Health Community Dent.* 2013;7(3):161-5. doi: [10.5005/johcd-7-3-161](https://doi.org/10.5005/johcd-7-3-161).
9. Natarajan E, Eisenberg E. Contemporary concepts in the diagnosis of oral cancer and precancer. *Dent Clin North Am.* 2011;55(1):63-88. doi: [10.1016/j.cden.2010.08.006](https://doi.org/10.1016/j.cden.2010.08.006).
 10. Talwar V, Singh P, Mukhia N, Shetty A, Birur P, Desai KM, et al. AI-assisted screening of oral potentially malignant disorders using smartphone-based photographic images. *Cancers (Basel).* 2023;15(16):4120. doi: [10.3390/cancers15164120](https://doi.org/10.3390/cancers15164120).
 11. Khan MM, Frustino J, Villa A, Nguyen BC, Woo SB, Johnson WE, et al. Total RNA sequencing reveals gene expression and microbial alterations shared by oral pre-malignant lesions and cancer. *Hum Genomics.* 2023;17(1):72. doi: [10.1186/s40246-023-00519-y](https://doi.org/10.1186/s40246-023-00519-y).
 12. Nagler R, Weizman A, Gavish A. Cigarette smoke, saliva, the translocator protein 18 kDa (TSPO), and oral cancer. *Oral Dis.* 2019;25(8):1843-9. doi: [10.1111/odi.13178](https://doi.org/10.1111/odi.13178).
 13. Kirschnick LB, Schuch LF, Gondak R, Rivero ER, Gomes AP, Etges A, et al. Clinicopathological features of metastasis to the oral and maxillofacial region-multicenter study. *Head Neck Pathol.* 2023;17(4):910-20. doi: [10.1007/s12105-023-01588-0](https://doi.org/10.1007/s12105-023-01588-0).
 14. Applebaum E, Ruhlen TN, Kronenberg FR, Hayes C, Peters ES. Oral cancer knowledge, attitudes and practices: a survey of dentists and primary care physicians in Massachusetts. *J Am Dent Assoc.* 2009;140(4):461-7. doi: [10.14219/jada.archive.2009.0196](https://doi.org/10.14219/jada.archive.2009.0196).
 15. Pérez-Sayáns M, Somoza-Martín JM, Barros-Angueira F, Reboiras-López MD, Gándara-Vila P, Gándara Rey JM, et al. Exfoliative cytology for diagnosing oral cancer. *Biotech Histochem.* 2010;85(3):177-87. doi: [10.3109/10520290903162730](https://doi.org/10.3109/10520290903162730).
 16. Movahedinia L, Mansori K, Mirkeshavarz M. Knowledge and performance of senior dental students of Zanjan University of Medical Sciences (Iran) regarding the principles of oral biopsy and cytology. *J Craniomaxillofacial Res.* 2023;9(4):176-83. doi: [10.18502/jcr.v9i4.13384](https://doi.org/10.18502/jcr.v9i4.13384).
 17. Jayabalan J, Muthusekhar MR. Knowledge about exfoliative cytology among dental practitioners in Chennai city. *Drug Invention Today.* 2020;14(2):168-72.
 18. Beeula A, Muthukumar RS, Sreeja C, Gowri S, Nachiammai N, Jayaraj M. Awareness of oral exfoliative cytology among general dentists-a questionnaire study. *J Adv Med Dent Scie Res.* 2020;8(9):66-8. doi: [10.21276/jamdsr](https://doi.org/10.21276/jamdsr).
 19. Jairajpuri ZS, Rana S, Hajela A, Jetley S. Toward early diagnosis of oral cancer: diagnostic utility of cytomorphological features, a pilot study. *Natl J Maxillofac Surg.* 2019;10(1):20-6. doi: [10.4103/njms.NJMS_12_17](https://doi.org/10.4103/njms.NJMS_12_17).
 20. Silva WA, Lima AP, Vasconcellos LM, Anbinder AL. Evaluation of dentists' knowledge of the use of oral exfoliative cytology in clinical practice. *Braz Oral Res.* 2014;28. doi: [10.1590/1807-3107bor-2014.vol28.0010](https://doi.org/10.1590/1807-3107bor-2014.vol28.0010).
 21. Shailla M, Shetty P, Decruz AM, Pai P. The self-reported knowledge, attitude and the practices regarding the early detection of oral cancer and precancerous lesions among the practising dentists of Dakshina Kannada-a pilot study. *J Clin Diagn Res.* 2013;7(7):1491-4. doi: [10.7860/jcdr/2013/5321.3171](https://doi.org/10.7860/jcdr/2013/5321.3171).
 22. Shadid RM, Habash G. Knowledge, opinions, and practices of oral cancer prevention among Palestinian practicing dentists: an online cross-sectional questionnaire. *Healthcare (Basel).* 2023;11(7):1005. doi: [10.3390/healthcare11071005](https://doi.org/10.3390/healthcare11071005).
 23. Shah P, Deshmukh R. Exfoliative cytology and cytocentrifuge preparation of oral premalignant and malignant lesions. *Acta Cytol.* 2012;56(1):68-73. doi: [10.1159/000332917](https://doi.org/10.1159/000332917).
 24. Shadid RM, Abu Ali MA, Kujan O. Knowledge, attitudes, and practices of oral cancer prevention among dental students and interns: an online cross-sectional questionnaire in Palestine. *BMC Oral Health.* 2022;22(1):381. doi: [10.1186/s12903-022-02415-8](https://doi.org/10.1186/s12903-022-02415-8).
 25. Khurshid Z, Zafar MS, Khan RS, Najeeb S, Slowey PD, Rehman IU. Role of salivary biomarkers in oral cancer detection. *Adv Clin Chem.* 2018;86:23-70. doi: [10.1016/bs.acc.2018.05.002](https://doi.org/10.1016/bs.acc.2018.05.002).
 26. Sood A, Mishra D, Yadav R, Bhatt K, Priya H, Kaur H. Establishing the accuracy of a new and cheaper sample collection tool: oral cytology versus oral histopathology. *J Oral Maxillofac Pathol.* 2020;24(1):52-6. doi: [10.4103/jomfp.JOMFP_273_19](https://doi.org/10.4103/jomfp.JOMFP_273_19).
 27. Olms C, Hix N, Neumann H, Yahiaoui-Doktor M, Remmerbach TW. Clinical comparison of liquid-based and conventional cytology of oral brush biopsies: a randomized controlled trial. *Head Face Med.* 2018;14(1):9. doi: [10.1186/s13005-018-0166-4](https://doi.org/10.1186/s13005-018-0166-4).
 28. Surendran S, Poothakulath Krishnan R, Ramani P, Ramalingam K, Jayaraman S. Role of ceramide synthase 1 in oral leukoplakia and oral squamous cell carcinoma: a potential linchpin for tumorigenesis. *Cureus.* 2023;15(7):e42308. doi: [10.7759/cureus.42308](https://doi.org/10.7759/cureus.42308).
 29. Kumari P, Debta P, Dixit A. Oral potentially malignant disorders: etiology, pathogenesis, and transformation into oral cancer. *Front Pharmacol.* 2022;13:825266. doi: [10.3389/fphar.2022.825266](https://doi.org/10.3389/fphar.2022.825266).
 30. Pandarathodiyil AK, Vijayan SP, Milanese D, Chopra V, Anil S. Adjunctive techniques and diagnostic aids in the early detection of oral premalignant disorders and cancer: an update for the general dental practitioners. *J Pharm Bioallied Sci.* 2022;14(Suppl 1):S28-S33. doi: [10.4103/jpbs.jpbs_635_21](https://doi.org/10.4103/jpbs.jpbs_635_21).
 31. Coppola N, Mignogna MD, Riviaccio I, Blasi A, Bizzoca ME, Sorrentino R, et al. Current knowledge, attitudes, and practice among health care providers in OSCC awareness: systematic review and meta-analysis. *Int J Environ Res Public Health.* 2021;18(9):4506. doi: [10.3390/ijerph18094506](https://doi.org/10.3390/ijerph18094506).
 32. Gopal D, Malathi N, Reddy BT. Efficacy of oral exfoliative cytology in diabetes mellitus patients: a light microscopic and confocal microscopic study. *J Contemp Dent Pract.* 2015;16(3):215-21. doi: [10.5005/jp-journals-10024-1664](https://doi.org/10.5005/jp-journals-10024-1664).