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Evaluation of Candidal Species in Oral Submucous Fibrosis and Oral Lichen Planus: A Microbiological Study

Ashok Vikey [a++*] and Astha Pusame [a#]

[a] *Department Oral and Maxillofacial Pathology Govt. College of Dentistry, MPMSU, Indore, M.P. India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background: Candida is opportunistic microorganisms in oral cavity, causes oral candidiasis. The presence of candida and subspecies in oral premalignant lesions may intensify the infection and transform pre malignant lesions into cancer.
Objective: To isolate various types of candida species, among Oral submucous fibrosis (OSMF) and Oral lichen Planus (OLP) patients.
Methodology: Total 60 individuals included and grouped as; OSMF (n=20) group A, Lichen Planus (n=10); group B and Controls (n=30) group C.
Results: The higher candida carriage revealed in OSMF+ OLP groups (23.3%) as compared to controls (10%). The species level findings showed 13.3% of candida albicans in OSMF+ OLP and 6.7% in controls, candida krusei 6.7% in OSMF+ OLP and 3.3% in controls and non candida albicans were 10% in OSMF+ OLP and 6.7% in control group respectively.

[++]*Associate Professor;*
[#]*Post Graduate student;*
**Corresponding author: E-mail: drvikey@yahoo.co.in; drvikey@yahoo.in;*

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Conclusion: This basic understanding of candida species and their association with potentially malignant disorders will help in better interventions, so as to restrict the lesion before it transform in to malignancy.

Keywords: Candida; oral submucous fibrosis; oral lichen planus; oral cancer; infection; hyperplasia.

1. INTRODUCTION

Oral candidiasis is an infection of the oral cavity, first documented in 1838 by paediatrician Francois Veilleux. Often referred to as "thrush," this opportunistic fungal infection typically affects the oral mucosa [1]. The 'Candida albicans" is a part of oral flora and an opportunistic pathogen is main causative agent [2]. "The ability of *C. albicans* to colonize, penetrate and damage host tissues depends on an imbalance between C. albicans virulence factors and host defence" [3]. "Combining a Candida causative agent in the mouth with epithelial alterations such atrophy, hyperplasia, and dysplasia can result in candida infection, which compromises the mucosal barrier and allows candidal invasion" [4,5]. "Some strains of Candida with high nitrosamination potential were isolated from lesions with advanced precancerous changes. Nitrosamines and N-nitrosobenzylmethylamine are two examples of the carcinogenic substances that Candida can produce. In such cases candida yeast cells non pathogenic form transform into pathogenic hyphae extends from the mucosal surface to the deeper epithelial cell layers representing transport and deposition of precursors like nitrosamines to deeper layers. This showed that certain strains of *C. albicans* play a key role in the development of dysplasia"[6]. Therefore candida may have a role in the etio-pathogenesis of oral premalignant lesions such as oral lichen planus (OLP) and oral submucous fibrosis (OSMF).

"Oral submucous fibrosis (OSMF), the most common occurring potentially premalignant oral epithelial lesion is a chronic disorder linked with areca nut chewing. It has a relatively high potential for malignant transformation resulting in oral squamous cell carcinoma (OSCC), the most prevalent oral malignancy with a high mortality rate"[7]. "Paymaster reported the malignant potential of OSMF in 1956, rate of this condition has been estimated to be 7-13% with younger age groups being affected, due to alterations in habit patterns. Which lists it as one of the highly significant oro-facial healthcare issues due to chewing areca nut as a potentially malignant disease" [8]. According to WHO this is "a generalized pathological state of the oral mucosa associated with a significantly increased risk of cancer [9]. "Despite of advancing field of healthcare technology, it shows a gradual increase in graphs. This shows varied clinical presentations including; burning sensations, blanching of oral mucosa, reduced mouth opening, and decreased salivary flow rate" [5].

Lichen planus is a chronic inflammatory and autoimmune mucocutaneous disease which frequently involves the oral mucosa, that affects 1–2% of the population frequently in the fourth decade of life and affects women more than men in a ratio of 1.4:1 [10,11].The term lichen planus (LP) stems from the Greek word "leichen," which means "tree moss and the Latin word "planus," which means "flat," The term is derived from word "Lichen" which means primitive plants composed of symbiotic algae & fungi. The word 'Planus" is Latin word which means flat. The exact cause of LP is unknown; but is thought to be an immunologically mediated disorder. An immune response presumably mediated by CD4+ and CD8+ T lymphocytes appears to develop in the oral mucosa, which produces cytokines such as interleukin-2 and tumour necrosis factor (TNF) and induces a chronic inflammatory response and apoptosis of keratinocytes. This is clinically characterized by a bilateral and symmetrical distribution, mainly affecting the buccal mucosa, the tongue, and gingiva. According to Anderson's clinical classification distinguishes between six clinical forms: Reticular, atrophic, erosive, papular, plaque, and bullous [5].

2. MATERIALS AND METHODS

This case-control study was conducted in the Department of Oral & Maxillofacial Pathology and Microbiology at a Dental college in (M. P.) India after approv by the Institutional Ethical Review Board. All subjects provided a signed inform consent to participate in the study. The patients who visited at study centre were screened for potentially malignant disorders. A total number of 60 individuals were included of which 30 individuals had clinically diagnosed as oral 'potentially malignant disorders' (OPMDs), (OSMF, n=20, group A, Lichen Planus, n=10, group B) and controls (Normal, n=30, group C).

Detailed clinical history and oral examinations of all the individuals with consent were carried out using diagnostic instruments. Saliva sample using a cotton swab was obtained from the representative site of OPMDs and control group patients. Selection of desired samples was done by using simple random sampling technique according to inclusion-exclusion criterion'' and obtained data of result is analysed statically.

2.1 Inclusion Criteria

1. Age group, 20-80 year
2. Gender, both males and females
3. Clinically diagnosed cases of Potentially Malignant Disorders such as Oral Submucous Fibrosis and Oral Lichen Planus.

2.2 Exclusion Criteria

1. Patients already on Anti-Fungal therapy.
2. Patients with history of cardiac disease, diabetes, pregnant females, critically ill patients, mental disorders and other systemic illness.

2.3 Saliva Sample and Microbiological Parameters

Saliva was collected using a sterile cotton swab from the representative site of OPMDs, control group patients and inoculated on media CHROME CANDIDA DIFFERENTIAL AGAR (Manufactured by- Himedia Laboratories, Mumbai)and plates were incubated in incubator for 48 hours at 37°C.It is a selective medium to differentiate *c. albicans* and non albicans species based on the colony colour. Media composition included (Peptic digest of animal tissue, Peptone special15gms/l, Malt extract, Dipotassium hydrogen posphate1.0gms/l,Yeast extract 4.0gms/l,Glucose,Chloramphenicol0.5gms/l,Chromogenic,mixture7.2gms/l,Agar15.0gms/l,Final pH (at 25°C)6.3_+ 0.2gms/l).42.72 grams of dehydrated media was weighed on digital weighing machine and suspended in 1000 ml of distilled water. It was heated to boiling to dissolve the medium completely. Autoclaving is not required. The media was cooled to 50°C and poured into sterile Petri plates.

3. PRINCIPLE

Perry and Miller reported that Candida albicans produces an enzyme b –N acetyl-galactosaminidase and according to Rousselle et al incorporation of Chromogenic or fluorogenic hexosaminidase substrates into the growth medium helps in identification of C.albicans isolates directly on primary isolation.

3.1 Demonstration of Colony colour shown By Candida Species OnChromagar Media

List 1. Demonstration of Colony colour shown By Candida Species OnChromagar Media

Candida Species	Colour of the colony on CHROM Agar
Candida albicans	Light green
Candida parapsilosis	Cream colored
Candida tropicalis	Blue with pink halo
Candida krusei	Pink
Candida glabrata	Purple
Candida dubliniensis	Dark green

3.2 Demonstration of Morphological Parameters

C. albicans and *C. dublinensis* have capacity to create morphological traits known as chlamydospores (filamentous, cylindrical germ tube) were assessed using the germ-tube test, which is the standard laboratory method to identify and differentiate the *C. albicans* from other species. The test involves the induction of hyphal outgrowths (germ tubes) when subcultured in horse serum at 37◦C for 2– 4 hours. Approximately 95% of *C. albicans* isolates produce germ tubes. All strains of *C. albicans* are positive in this test and no other commonly encountered species demonstrate this reaction for *C. albicans* and *C. dublinensis*. Sample showing such germ tube was considered as positive. Samples showing absence of germ tubes or formation of germ tubes with constricted base were considered negative.

3.3 Sugar Assimilation Tests

After application of Germ tube test, the isolates were further subjected to Sugar assimilation tests. The capacity of the sugar assimilation test to assimilate various sugars for their growth was also evaluated. The growth indicates the organism's capacity to assimilate a certain type of carbohydrate found in the disc. The lack of growth surrounding the disc indicated that the

organism was unable to utilize the sugar for growth. The Positive result indicates growth near or around a particular carbohydrate differentiation disc, while Negative result shows no growth near or around a particular carbohydrate differentiation disc.

Final identification of the species was done on the basis of all above tests.

Antifungal susceptibility of each isolated species was done using disc diffusion method and for this antifungal disc (Himedia Laboratories) were used.

Media used for antifungal susceptibility testing was Muller Hinton agar with methylene blue for inhibiting bacterial growth. Zone of inhibition refers to the area around the drug discs where the micro-organism is unable to grow. The candida isolates showing zone of inhibition more than the above minimum zone of inhibition values were considered as sensitive to the particular antifungal drug. Those isolates of candida which were showing lesser zone of inhibition than the above mentioned values were considered to be resistant.

4. RESULTS

The study included 60 subjects, 20 (33.3%) subjects were patients of OSMF, 10 (16.7%) patients had oral lichen planus and 30 (50.0%) subjects were healthy controls [Fig. 1].

The majority (31.7%) of the subjects belonged to the age group of 41-50 years of age [Fig. 2].

List 2. Antifungal susceptibility

DRUG	CONCENTRATION	MINIMUM ZONE OF INHIBITION
Nystatin	100 units/disc	19-27 mm
Amphotericin B	100 units/disc	10-17 mm
Fluconazole	10µgm/disc	27-38 mm
Clotrimazole	10µgm/disc	18-32 mm

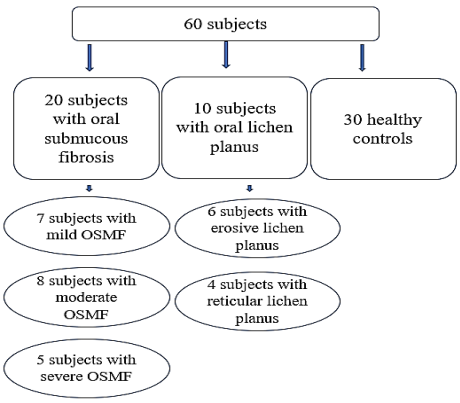

Fig. 1. Distribution of study subjects based on clinical types of OSMF & OLP

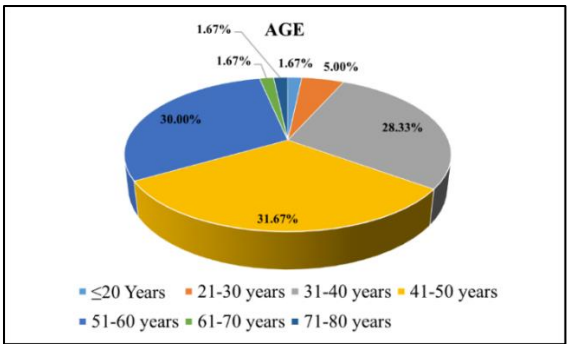

Fig. 2. Distribution of study subjects based on age

The mean age of all subjects was 45.0±10.623 years. The mean age of the subjects in the OSMF+OLP group and control group was 43.6±11.955 years and 46.66 ± 9.084 years respectively. The difference in the mean age of the subjects belonging to 2 groups was statistically non-significant (p-value= .306). Male preponderance was observed among the study subjects [male vs. female= 44 (73.3%) vs.16 (26.7%)]. However, there was no significant difference in the proportion of males and females between the two groups. The male vs. female percentage in OSMF + OLP group was 83.3% vs. 16.7% and in the control group was 63.3% vs. 36.7% [Chi-square value= 3.068, df-1, p-value= .080].

Among the study subjects, smoking prevailed among 22 (36.7%) subjects and smokeless tobacco consumption was prevalent among 40 (66.7%) subjects. Among all the subjects with OSMF and OLP, buccal mucosa was involved.

Histopathologically, among the patients of OLP (n=10), 60.0% (6/10) had erosive lichen planus and 40.0% (4/10) had reticular lichen planus. Among the patients with OSMF (n=20), 7 (35%) patients had mild, 8 (40%) patients had moderate, and 5 (25%) patients had severe OSMF. [Fig. 1]

The culture report was positive for 10 (16.7%) subjects. A greater proportion of subjects in the OSMF + OLP group had positive culture reports compared to the control group, however, the difference was statistically non-significant (p-value>.05) [Table1& Fig. 3].

On further comparing two groups with respect to various types of candida species, it was found that no specific candida species were significantly associated with either OSMF+OLP (p-value >.05) [Table 2& Fig. 4].

Table 1. Comparison of culture report between subjects belonging (OSMF+OLP) and Control groups

Culture report	Oral lesion or condition		Total	Chi-square value	Df	p-value
	OSMF + OLP (n=30)	Control (n=30)				
Positive	7 (23.3%)	3 (10.0%)	10 (16.7%)	1.920	1	.166
Negative	23 (76.7%)	27 (90.0%)	50 (83.3%)			

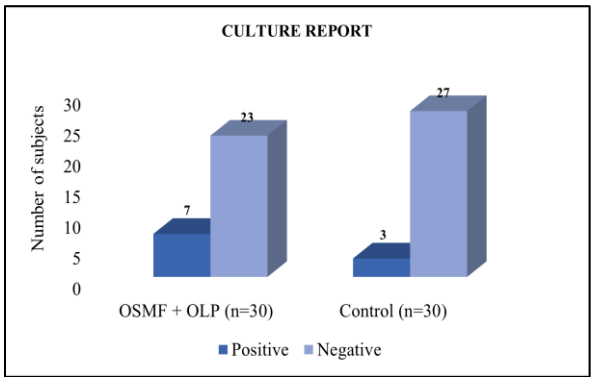

Fig. 3. Comparison of culture report between subjects belonging (OSMF+OLP) and Control groups

Table 2. Different types of candida species and their association among OSMF+OLP and Controls

	OSMF + OLP	Control	Total	Chi-square value	Df	p-value
Candida *albicans*	4 (13.3%)	2 (6.7%)	6 (10.0%)	.741	1	.389
Candida *tropicalis*	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
Candida *dubliniensis*	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
Candida *krusei*	2 (6.7%)	1 (3.3%)	3 (5.0%)	.351	1	.554
Candida *parapsilosis*	0 (0.0%)	1 (3.3%)	1 (1.7%)	1.017	1	.313
Non-candida *albicans*	3 (10.0%)	2 (6.7%)	5 (8.3%)	.218	1	.640

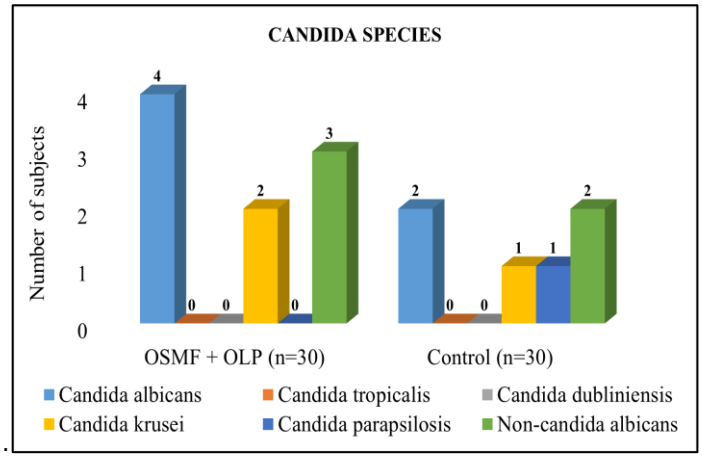

Fig. 4. Different types of candida species and their association among OSMF+OLP and Controls

5. DISCUSSION

Presently there is increasing importance and interest in Oral Candida infections and their role in oral cancer. It has been matched by an increasing number of publications related to this topic appearing in the world medical literature. But still very few studies have been undertaken till date to assess the association of candida with oral potentially malignant disorders of oral mucosa such as OSMF and OLP to the level of species identification. Till now research has largely focused on studying candida albicans but very infrequently non-candida albicans species. Various studies performed have shown rather wide range of similarities in results. Some have reported insignificant association of candida in OLP and OSMF, while few have reported significant associations. According to Alnuaimi A et al & Amberpreet K et al ., it was also hypothesized that certain species, or strains and high Candidal oral carriage are associated with the presence of oral cancer and high level of colonization are risk factors in oral cancer [12,13].

Today, for diagnosis of oral candidiasis, very limited laboratory tests available and they are not always performed. A presumptive diagnosis is often made, based on the patient's history, clinical presentation, and response to antifungal treatment rather than on cultural and histological methods Gonsalves et al. [14]. However, especially in critical patients, the characterization of yeast infection is important when choosing the appropriate therapy. Similarly a study by Aslam, S., & Ghafoor, S. [15] shows association of Candida species with Novel SARS-CoV-2 which can be a biomarkers for fungal related premalignant oral lesions for interventions .Therefore, in precancer patients, the diagnosis of oral candidiasis should always be performed. Epithelial changes such as atrophy or dysplasia could improve after elimination of Candida species, and resolution of infection can prevent more aggressive candidiasis after radio-chemotherapy. According to Galle et al . [16] microbiological analysis is a reliable method to access the presence of candida species in advance and possibly establish a treatment for precancerous lesions on basis of antifungal susceptibility patterns shown by isolated organisms.

The purpose of this study was to isolate and identify various candida species, their confirmation up to species level by various microbiological methods and to evaluate its occurrence among the patients of oral potentially malignant disorders of oral mucosa such as OSMF and OLP.

In our study higher candida carriage was revealed in OSMF+ OLP patients (23.3%) were revealed higher as compared to controls (10%); (Table 1& Fig. 3). Our findings were in accordance with findings of Anila et al., Ariyawardana A, , Kumar et al., [17,18,19]. A few studies in Australia & India investigating the association between the presence of Candida in OPMDs and OC with high carriage have also been reported compared to patients with apparently normal oral cavity [20]. According to Ariyawardana A, clinical candidal carriage of OSMF was (63.6%) and controls showed (50%) [18] and findings of Kumar et al. showed 40%

and 15% respectively [18] Mehdipour et al. [21] studied candidal carriage in oral lichen planus and found higher levels as compared to controls [20] The isolation of candida at species level has performed in limited studies, but our findings have similarities with findings of Kumar et al., and Dixit et al [19,22] which shows the association between different types of candida species (candida albicans + non candida albicans) and occurrence of OSMF+OLP (Table 2, Fig. 4).

We also observed different species of candida as follows; candida albicans [OSMF+ OLP (13.3 %) ,control (6.7%)] , candida krusei [OSMF+ OLP (6.7%) ,control (3.3%)] and non candida albicans [OSMF+ OLP (10.0%) ,control (6.7%)] (Table 2 & Fig. 4). These findings are in accordance to studies by Ariyawardana A, [18], Kumar et al. [19] and Galle et al ., [16]. In one study we use the germ tube test as sole method for identification and differentiate candida albicans from other species. On the basis of our above findings in OSMF+ OLP compared with control group, increased candida carriage in OSMF and OLP especially Candida albicans in oral carcinogenesis can be seen as significant virulent factors for patients concerning morphological phenotype changes in cell structure and genotype and contribute to the formation of carcinogenic substances that can affect cell development towards malignancy [23] implies that alteration in the overlying epithelium would breach the physiological barrier, thereby favouring a conductive microenvironment that eventually increases the colonization of candida which might indicate an increased risk of developing cancer due to the inflammation and immune response triggered by the Candida overgrowth, which can promote the development of cancerous cells. Thus our study focuses on precancerous states prior to transform in malignancy, so as to strengthen further interventions.

6. CONCLUSION

Assessment of Candida organisms in precancerous lesions in the oral cavity is important for several reasons such as; association with oral cancer risk and indicator of local immune response. Later can also contribute to the persistence of precancerous lesions and increase the risk of malignant transformation by altering microenvironment of the oral mucosa to promote cancer development and progression. Timely therapeutic considerations of antifungal therapy can be useful to manage candida colonization to restrict further progress of precancerous lesions. So overall this provides insights into the local immune response, tissue microenvironment, and potential risk of malignant transformation, guiding therapeutic decisions and improving patient outcomes.

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vila T, Sultan AS, Montelongo-Jauregui D, Jabra-Rizk MA. Oral candidiasis: A disease of opportunity. J Fungi (Basel). 2020;6(1):15.
DOI: 10.3390/jof6010015.
2. More C, Peter R, Nishma G, Chen Y, Rao N. Association of Candida species with Oral Submucous Fibrosis and Oral Leukoplakia: A Case Control study. Ann Clin Lab Res. 2018;6(3).
DOI: 10.21767/2386-5180.100248.
3. Mohd Bakri M, Mohd Hussaini H, Rachel Holmes A, David Cannon R, Mary Rich A. Revisiting the association between candidal infection and carcinoma, particularly oral squamous cell carcinoma. J Oral Microbiol. 2010;2(1):5780.
DOI: 10.3402/jom.v2i0.5780.
4. Sitheeque MAM, Samaranayake LP. Chronic hyperplastic candidosis/candidiasis (candidal leukoplakia). Crit Rev Oral Biol Med. 2003;14(4):253–67.
DOI: 10.1177/154411130301400403.
5. Gupta B, Chandra S, Raj V, Gupta V. Comparison of salivary flow and candidal carriage in patients with oral submucous fibrosis. J Oral Maxillofac Pathol. 2015; 19(2):158–63.
DOI: 10.4103/0973-029X.164526.

6. O'Grady JF, Reade PC. Candida albicans as a promoter of oral mucosal neoplasia. Carcinogenesis. 1992;13(5):783–6.
   DOI: 10.1093/carcin/13.5.783.
7. Phulari RGS, Dave EJ. A systematic review on the mechanisms of malignant transformation of oral submucous fibrosis. Eur J Cancer Prev. 2020;29(5):470–3.
   DOI: 10.1097/CEJ.000575.
8. Jha VK, Kandula S, Ningappa Chinnannavar S, Rout P, Mishra S, Bajoria AA. Oral submucous fibrosis: Correlation of clinical grading to various habit factors. J Int Soc Prev Community Dent. 2019;9(4):363–71.
   DOI: 10.4103/jispcd.JISPCD_92_19.
9. Singh A, Pandey A, Sharma N, Dhiman N, Jaiswara C, Tiwari P, et al. Comparative evaluation of buccal pad of fat with and without bovine collagen membrane in the management of oral submucous fibrosis: A prospective clinical study. Natl J Maxillofac Surg. 2020;11(1):57.
   DOI: 10.4103/njms.njms_70_19.
10. Boorghani M, Gholizadeh N, Taghavi Zenouz A, Vatankhah M, Mehdipour M. Oral lichen planus: Clinical features, etiology, treatment and management; a review of literature. J Dent Res Dent Clin Dent Prospects. 2010;4(1):3–9.
    DOI: 10.5681/joddd.2010.002.
11. Lavanya N, Jayanthi P, Rao UK, Ranganathan K. Oral lichen planus: An update on pathogenesis and treatment. J Oral Maxillofac Pathol. 2011;15(2):127–32.
    DOI: 10.4103/0973-029X.84474.
12. Alnuaimi AD, Wiesenfeld D, O'Brien-Simpson NM, Reynolds EC, McCullough MJ. Oral Candida colonization in oral cancer patients and its relationship with traditional risk factors of oral cancer: a matched case-control study. Oral Oncol. 2015;51(2):139–45.
    DOI: 10.1016/j.oraloncology.2014.11.008.
13. Khangura AK, Gupta S, Mehta M, Gulati A. Isolation and identification of various Candida species in potentially malignant disorders of oral cavity: A retrospective study. Int J Trop Dis Health. 2022;32–44.
    DOI: 10.9734/ijtdh/2022/v43i630597.
14. Gonsalves WC, Wrightson AS, Henry RG. Common oral conditions in older persons. Am Fam Physician. 2008;78(7):845–52.
    Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/18841733.
15. Aslam S, Ghafoor S. Association of Candida Species with Novel SARS-CoV-2 and Biomarkers for Fungal Premalignant Oral Lesions. J Pak Med Assoc. 2022;72(9):1827–30.
    DOI: 10.47391/JPMA.4632.
16. Gall F, Colella G, Di Onofrio V, Rossiello R, Angelillo IF, Liguori G. Candida spp. in oral cancer and oral precancerous lesions. New Microbiol. 2013;36(3):283–8.
    Available:https://www.ncbi.nlm.nih.gov/pubmed/23912870.
17. Anila K, Hallikeri K, Shubhada C, Naikmasur VG, Kulkarni RD. Comparative study of Candida in oral submucous fibrosis and healthy individuals. Rev Odontociênc. 2011;26(1):71–6.
    DOI: 10.1590/s1980-65232011000100016.
18. Ariyawardana A, Panagoda GJ, Fernando HN, Ellepola ANB, Tilakaratne WM, Samaranayake LP. Oral submucous fibrosis and oral yeast carriage - a case control study in Sri Lankan patients. Mycoses. 2007;50(2):116–20.
    DOI: 10.1111/j.1439-0507.2006.01330.x.
19. Kumar RS, Ganvir S, Hazarey V. Candida and calcofluor white: Study in precancer and cancer. J Oral Maxillofac Pathol. 2009;13(1):2–8.
    DOI: 10.4103/0973-029X.44575.
20. Alnuaimi AD, Wiesenfeld D, O'Brien-Simpson NM, Reynolds EC, McCullough MJ. Oral Candida colonization in oral cancer patients and its relationship with traditional risk factors of oral cancer: a matched case-control study. Oral Oncol. 2015;51(2):139–45.
    DOI: 10.1016/j.oraloncology.2014.11.008.
21. Mehdipour M, Taghavi Zenouz A, Hekmatfar S, Adibpour M, Bahramian A, Khorshidi R. Prevalence of Candida species in erosive oral lichen planus. J Dent Res Dent Clin Dent Prospects. 2010;4(1):14–6.
    DOI: 10.5681/joddd.2010.004.
22. Dixit S, Goswami S, Dive A. Determination, distribution & phenotypic differentiation of Candida : Study in oral precancer and oral cancer. Indian J Dent Res Rev; 2012.

23. Ayuningtyas NF, Mahdani FY, Pasaribu TAS, Chalim M, Ayna VKP, Santosh ABR, et al. Role of Candida albicans in Oral Carcinogenesis. Pathophysiology. 2022; 29(4):650–62.
DOI: 10.3390/pathophysiology29040051.

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