

Intra Oral Mucosal Conditions in Older Patients With and Without Complete Dentures: A Cross-sectional Study.

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Research Article

Keywords: mucosal conditions, oral lesions, denture wearers, older patients

Posted Date: January 11th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1142204/v1>

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Abstract

Objectives: To obtain baseline information on Oral Mucosal Conditions (OMCs) and its relation to age, sex, medical history and the use of complete denture in a sample of edentulous patients.

Materials and methods: Edentulous patients attending a university hospital were examined for the presence of OMCs, and demographic data were recorded. Statistical analysis was carried out on SPSS software; the following statistical tests were utilized: descriptive statistics, The Mann Whitney U test, Spearman's Rho rank correlations, and The hierarchical logistic regression analysis.

Results: A total of one hundred and sixty-one participants were examined (34 females and 127 males with a mean age of 59.08 years). More than half of the participants (59.6 %) were non-denture wearers and (40.6%) were denture wearers. Longer edentulism, using dentures for longer duration, and the use of more previous dentures were associated with higher Atwood's ridge classification. Smoking was associated with higher prevalence of OMCs, particularly hairy tongue, frictional keratosis, smokers' palate, and leukoedema. Denture wearers had more denture stomatitis and denture induced hyperplasia, and less frictional keratosis than non-denture wearers. Participants with cardiac disease had more incidences of geographic tongue and tie tongue.

Conclusion: Mucosal changes with increased age, smoking, medical conditions, and medications may be superimposed by wearing complete dentures.

Introduction

Older patients are vulnerable to non-transmissible diseases, many of which share common risk factors with different oral diseases (1). Poor oral health associated with aging may be complicated by tooth loss, the use of removable denture, drug-induced xerostomia, the occurrence of potentially malignant conditions, the presence of systemic diseases, and the use of medications (1, 2) (3).

Epidemiological studies are important to know the state of oral health and the needs of treatment among elderly patients using or intending to use complete dentures (4). Studies in the literature counted the frequency of denture-related lesions in a number of countries such as Iran (5), Brazil (6, 7), Thailand (8) and Turkey (9). The current available information about the oral health of old population is scarce, especially in Arab countries, where research has been done in Yemen (1) and Saudi Arabia (10). The aim of this study is to obtain baseline information on the incidence of intra oral mucosal conditions in a population of edentulous patients visiting the dental department at Jordan University Hospital. Also we aim to explore the relation of mucosal conditions to age, sex, medical history and the use of complete dentures.

Materials Methods

This study was conducted in full accordance with the World Medical Declaration of Helsinki and conformed to STROBE Statement for observational studies. Ethical approval was granted from the research committee at Jordan University Hospital where this research was conducted (approval number: 10/2021/20527) and informed consent to participate and publish was obtained from participants. Sample size calculation was performed using a priori power analysis based on logistic regression test utilizing a computer software (G*Power, version 3.1.9.7; Heinrich-Heine University). One hundred and sixty one edentulous patients who attended the undergraduate, postgraduate and speciality clinics at the removable prosthodontic department at Jordan University Hospital (from January to June 2021) were recruited for this study. A random sample by age, gender, and socioeconomic status of edentulous patients was obtained. The patients were interviewed by one trained dentist whereby demographic information was collected about the patients. More emphasis was given to the medical history and medications taken by the patient, and smoking (amount and duration). Also questions were asked regarding past experience with complete denture (i.e. presence of dentures, sleeping with the denture, satisfaction with the denture, and about the number of previous dentures if applicable).

Thorough intraoral examination was then carried out by the same dentist. The areas which were examined are: the tongue, the cheeks, the floor of the mouth, and the palate according to the protocol by Mathew et al. 2008 (11). Figure (1) shows the sequence of mucosal tissues examination. Oral lesions and conditions were evaluated according to the WHO Guide to Epidemiology and Diagnosis of Oral Mucosal Diseases and Conditions (12). Suspicious lesions were biopsied and inspected by a specialist in oral medicine.

Statistical analysis:

The SPSS computer software (IBM SPSS Statistics v19.0; IBM Corp., USA) was utilized for the statistical analysis of the collected data in this investigation. Descriptive statistics and testing normal data distribution were carried out to summarize different study variables.

The Mann Whitney U test was utilized to identify differences in presence of oral lesions between genders, between smokers and non-smokers, between participants with systemic conditions and without systemic conditions, and between participants with dentures and without dentures. Spearman's Rho rank correlations were used to identify the correlations between Atwood's ridge classification, duration of edentulism, duration of using dentures and the number of previous dentures.

The significance of the conducted statistical results was considered at two tailed α of 0.05 and 95% confidence intervals.

The odds of presence of oral lesions were identified using the hierarchical logistic regression analysis. The contribution of different edentulism and denture related variables towards the presence of oral lesions was evaluated through the regression analysis considering the confounding effects of gender, age, smoking, having medical conditions, and taking medications.

Figure (1)

The sequence of mucosal tissues examination according to Mathew et al. 2008 (11).

Results

For sample size calculation a significance level (α) of 0.05, a statistic power ($1 - \beta$) of 0.8, an effect size of 0.3, and an odds ratio of 1.6, the required sample size was determined to be 144 participants. Extra participants were recruited to balance for participant drop outs and secure the required minimum sample size. One hundred and sixty one participants were invited to participate in the study and none was lost or declined after the invitation (drop out ratio was 0%).

The data was collected from a total of one hundred and sixty one participants (34 females and 127 males; mean age= 59.08 years old, SD= 9.04, SE= 0.713, range= 27 – 85, 95% CI= 57.68 – 60.49). One hundred and fifty two (94.4%) participants were married and 9 (5.6%) were single. The data was then processed and analysed.

Table (1) presents the descriptive statistics of smoking, medical conditions, presence of dentures, and oral lesions among the study participants. Table (2) shows the distribution of Atwood's ridge classification, duration of edentulism, and quantity and duration of smoking among the participants.

Among those who had dentures (65 participants), 36 (55.4%) participants were not satisfied with their dentures, meanwhile 29 (44.6%) were satisfied with their dentures. Also, 24 (36.9%) were used to sleep wearing their dentures; meanwhile 41 participants (63.1%) did not sleep with their dentures. Table (3) shows the number of old dentures among the study participants where the participants used dentures for 1 week to 30 years (Median= 4 years, Interquartile range= 9), and utilized 0 to 6 old dentures (Median= 1 denture, Interquartile range= 1).

Table (4) shows spearman's correlations between duration of edentulism, duration of using dentures, number of old dentures, and the Atwood's ridge classification among the study sample. Longer edentulism duration was associated with higher Atwood's ridge classification (i.e. more bone resorption of the ridge), using dentures for longer duration, and the use of more previous dentures ($P < .05$). Also, using dentures for longer duration was associated with higher Atwood's ridge classification in the lower ridge (i.e. more bone resorption) ($P < .05$) as demonstrated in table (4).

Table (5) presents the relationship between smoking and presence of oral lesions among the study population. Smoking was associated with more hairy tongue, frictional keratosis, smokers' palate, and leukoedema than non-smokers ($P < .05$) (Table 5). Participants with dentures were associated with denture stomatitis and denture fissuratum, and had less frictional keratosis than participants without dentures ($P < .05$) (Table 5). In addition, females had less Fordyce's granules, frictional keratosis, smoker palate, and leukoedema than males ($P < .05$) (Table 5).

Table 1
Distribution of smoking, medical conditions, presence of dentures, and oral lesions among the study population (N= 161).

Variables	All Sample		Males		Females	
	Fre	%	Fre	%	Fre	%
Smoking	95	59.0	88	69.3	7	20.6
Presence of Systemic Condition	77	47.8	57	44.9	20	58.8
Diabetes	45	28.0	35	27.6	10	29.4
Hypertension	36	22.4	28	22.0	8	23.5
Cardiac Disease	13	8.1	12	9.4	1	2.9
Cardiovascular Disease	45	28.0	36	28.3	9	26.5
On medications	68	42.2	51	40.2	17	50.0
Antidiabetic	38	23.6	29	22.8	9	26.5
Antihypertensive	29	18.0	22	17.3	7	20.6
Anticoagulant	26	16.1	22	17.3	4	11.8
Denture Presence	65	40.4	51	40.2	14	41.2
Fissured Tongue	72	44.7	60	47.2	12	35.3
Geographic Tongue	6	3.7	6	4.7	0	0
Hairy Tongue	78	48.4	65	51.2	13	38.2
Median Rhomboid Glossitis	1	0.6	1	0.8	0	0
Sublingual Varices	88	54.7	74	58.3	14	41.2
Leukoplakia	0	0	0	0	0	0
Fordyce's Granules	49	30.4	45	35.4	4	11.8
Frictional Keratosis	24	14.9	23	18.1	1	2.9
Lichen Planus	0	0	0	0	0	0
Smoker Palate	38	23.6	36	28.3	2	5.9
Denture Stomatitis	10	6.2	6	4.7	4	11.8
Papillary Hyperplasia of Palate	2	1.2	2	1.6	0	0
Fibrous Tuberosities	1	0.6	0	0	1	2.9

Fre= Frequency, %= Percentage.

Variables	All Sample		Males		Females	
	Fre	%	Fre	%	Fre	%
Leukoedema	67	41.6	63	49.6	4	11.8
Oral Candidiasis	0	0	0	0	0	0
Aphthus Stomatitis	0	0	0	0	0	0
Oral Submucous fibrosis	0	0	0	0	0	0
Oral Malignancy	0	0	0	0	0	0
Denture Fissuratum	6	3.7	4	3.1	2	5.9
Irritational Fibroma	2	1.2	2	1.6	0	0
Angular Chelitis	6	3.7	4	3.1	2	5.9
Herpes Labialis	4	2.5	2	1.6	2	5.9
Mucocele	0	0	0	0	0	0
Tongue Tie	2	1.2	2	1.6	0	0
Fre= Frequency, %= Percentage.						

Table 2

The distribution of Atwood's ridge classification, duration of edentulism, and quantity and duration of smoking among study participants.

	All participants			Males			Females		
	Median	IQR	Range	Median	IQR	Range	Median	IQR	Range
Atwood's upper anterior ridge classification	3	0	3-5	3	0	3-5	3	0	3-5
Atwood's upper posterior ridge classification	3	0	3-5	3	0	3-5	3	0	3-5
Atwood's lower anterior ridge classification	3	2	2-6	3	1	2-6	4	2	3-6
Atwood's lower posterior ridge classification	3	2	2-6	3	1	2-6	4	2	3-6
Duration of edentulism	3	6.3	0.04-35	3	6.25	0.04-35	1.25	6.17	0.04-35
Quantity of smoking	20	20	5-80	20	20	5-80	20	10	10-20
Duration of smoking	35	15	2-55	35	10	2-55	20	5	10-40
IQR: inter-quartile range									

Table 3

The distribution of the number of old dentures among study participants.

Number of old dentures	Frequency of participants (N=65)	Percentage of participants %
0	2	3.1
1	42	64.6
2	10	15.4
3	6	9.2
4	3	4.6
6	2	3.1
Total	65	100%

Table 4

Spearman's ranks test of correlations between duration of edentulism, duration of using dentures, number of old dentures, and the Atwood's ridge classification among the study sample.

	Spearman's test statistics	Duration of edentulism	Duration of using dentures	Number of old dentures
Atwood's upper anterior ridge classification	R	.189*	.222	-.004
	P	.017	.082	.977
Atwood's upper posterior ridge classification	R	.154	.203	.025
	P	.051	.114	.841
Atwood's lower anterior ridge classification	R	.317*	.293*	.093
	P	.000	.021	.462
Atwood's lower posterior ridge classification	R	.307*	.258*	.157
	P	.000	.043	.212
Duration of edentulism	R	1.000	.779*	.332*
	P	---	.000	.007
R= Spearman's Rho correlation coefficient, P= Two-tailed probability value.				

Table 5

Differences in oral lesions between smokers and non-smokers and denture and non-denture participants among the study population (N= 161).

Oral lesions	Smoking vs non-smoking			Dentures vs no dentures			Females vs males		
	MWU	Z	P	MWU	Z	P	MWU	Z	P
Fissured Tongue	2691.0	-1.772	.076	2953.5	-.666	.505	1901.0	-1.241	.215
Geographic Tongue	3017.5	-1.231	.218	3073.5	-.488	.625	2057.0	-1.288	.198
Hairy Tongue	2251.5	-3.508	.000	2678.0	-1.759	.079	1879.5	-1.337	.181
Median Rhomboid Glossitis	3102.0	-.834	.405	3087.5	-.823	.411	2142.0	-.517	.605
Sublingual Varices	2980.0	-.618	.537	2840.5	-1.117	.264	1790.0	-1.772	.076
Leukoplakia	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Fordyce's Granules	2981.0	-.664	.507	3102.5	-.076	.940	1648.0	-2.656	.008
Frictional Keratosis	2665.0	-2.619	.009	2742.5	-2.108	.035	1831.5	-2.199	.028
Lichen Planus	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Smoker Palate	2283.5	-3.979	.000	2770.5	-1.637	.102	1674.0	-2.731	.006
Denture Stomatitis	2982.0	-1.258	.208	2640.0	-3.956	.000	2007.0	-1.506	.132
Papillary Hyperplastic Palate	3069.0	-1.182	.237	3104.5	-.278	.781	2125.0	-.734	.463
Fibrous Tuberosities	3087.5	-1.200	.230	3072.0	-1.215	.224	2095.5	-1.933	.053
Leukoedema	1648.5	-5.984	.000	2794.0	-1.316	.188	1342.0	-3.963	.000
Oral Candidiasis	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Aphthous Stomatitis	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000

M-W U= Mann Whitney U test coefficient, Z= Z statistics using Mann Whitney U test, P= Two-tailed probability value.

Oral lesions	Smoking vs non-smoking			Dentures vs no dentures			Females vs males		
	MWU	Z	P	MWU	Z	P	MWU	Z	P
Oral Submucous Fibrosis	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Oral Malignancy	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Denture Fissuratum	3011.0	-1.299	.194	2832.0	-3.024	.002	2100.0	-.745	.456
Irritational Fibroma	3120.5	-.260	.795	3024.0	-1.724	.085	2125.0	-.734	.463
Angular Cheilitis	3098.0	-.388	.698	3086.0	-.357	.721	2100.0	-.745	.456
Herpes Labialis	3106.0	-.370	.712	3070.5	-.633	.527	2066.0	-1.429	.153
Mucocele	3135.0	.000	1.000	3120.0	.000	1.000	2159.0	.000	1.000
Tongue Tie	3120.5	-.260	.795	3055.0	-1.167	.243	2125.0	-.734	.463
M-W U= Mann Whitney U test coefficient, Z= Z statistics using Mann Whitney U test, P= Two-tailed probability value.									

Table 6

Differences in oral lesions between presence and absence of medical condition among the study population (N= 161).

Oral lesions	Cardiac disease vs no cardiac disease			Antihypertensives vs no antihypertensives			Anticoagulants Vs no anticoagulants		
	MWU	Z	P	MWU	Z	P	MWU	Z	P
Fissured Tongue	786.0	-1.268	.205	1911.5	-.013	.990	1483.5	-1.448	.148
Geographic Tongue	840.0	-2.307	.021	1759.5	-2.072	.038	1591.5	-2.289	.022
Hairy Tongue	696.5	-1.903	.057	1910.0	-.020	.984	1626.5	-.682	.495
Median Rhomboid Glossitis	955.5	-.296	.767	1899.5	-.469	.639	1742.0	-.439	.661
Sublingual Varices	809.5	-1.097	.272	1580.0	-1.704	.088	1611.0	-.767	.443
Leukoplakia	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Fordyce's Granules	717.0	-1.907	.056	1686.5	-1.256	.209	1506.5	-1.432	.152
Frictional Keratosis	806.0	-1.569	.117	1807.5	-.759	.448	1523.5	-1.724	.085
Lichen Planus	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Smoker Palate	956.5	-.046	.963	1685.0	-1.370	.171	1583.0	-1.074	.283
Denture Stomatitis	897.0	-.965	.335	1898.0	-.168	.866	1705.5	-.544	.586
Papillary Hyperplastic Palate	949.0	-.420	.674	1885.0	-.665	.506	1700.5	-1.305	.192
Fibrous Tuberosities	955.5	-.296	.767	1899.5	-.469	.639	1742.0	-.439	.661
Leukoedema	929.0	-.240	.810	1828.0	-.443	.658	1608.5	-.788	.431
Oral Candidiasis	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Aphthous Stomatitis	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000

M-W U= Mann Whitney U test coefficient, Z= Z statistics using Mann Whitney U test, P= Two-tailed probability value.

Oral lesions	Cardiac disease vs no cardiac disease			Antihypertensives vs no antihypertensives			Anticoagulants Vs no anticoagulants		
	MWU	Z	P	MWU	Z	P	MWU	Z	P
Oral Submucous Fibrosis	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Oral Malignancy	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Denture Fissuratum	923.0	-.738	.461	1827.0	-1.166	.243	1677.0	-1.092	.275
Irritational Fibroma	949.0	-.420	.674	1862.5	-1.181	.238	1700.5	-1.305	.192
Angular Chelitis	923.0	-.738	.461	1840.0	-.992	.321	1752.5	-.035	.972
Herpes Labialis	936.0	-.598	.550	1891.5	-.367	.714	1703.0	-.886	.376
Mucocele	962.0	.000	1.000	1914.0	.000	1.000	1755.0	.000	1.000
Tongue Tie	894.5	-2.183	.029	1885.0	-.665	.506	1729.0	-.623	.534
M-W U= Mann Whitney U test coefficient, Z= Z statistics using Mann Whitney U test, P= Two-tailed probability value.									

Table (7): Prediction of presence of oral lesions using edentulism and denture related factors considering other demographic and systemic condition related covariates (N=161).

Predicting variables for oral lesion*	N2-R ²	HL2-P	B	SE	df	P	OR	95% CI of OR	
								Lower	Upper
Fissured tongue	.517	.174							
Age			.174	.052	1	.001	1.190	1.075	1.318
Smoking			2.056	.850	1	.016	7.812	1.475	41.364
Diabetes			-3.678	1.851	1	.047	.025	.001	.951
Antidiabetics			4.901	2.118	1	.021	134.438	2.116	8539.674
Anticoagulants			3.000	1.340	1	.025	20.093	1.454	277.734
Presence of denture			-1.691	.798	1	.034	.184	.039	.881
Hairy tongue	.638	.793							
Smoking			2.063	.847	1	.015	7.866	1.496	41.355
Fordyce's granules	.296	.196							
Gender			-2.182	.919	1	.018	.113	.019	.683
Presence of dentures			-1.682	.718	1	.019	.186	.045	.760
Smoking palate	.518	.290							
Smoking			3.413	1.476	1	.021	30.367	1.683	548.030
Leukoedema	.508	.703							
Smoking			2.898	.871	1	.001	18.140	3.293	99.932
Diabetes			-3.894	1.977	1	.049	.020	.000	.982
Edentulism duration			-.154	.074	1	.037	.858	.742	.991

N2-R²= Nagelkerke R² for Block 2 of the regression model, HL2-P= Hosmer and Lemeshow test probability value (P) for Block 2 of the regression model, B= the B coefficient of the model, SE= Standard error, df= Degree of freedom, P= Two-tailed probability value, OR= Odds ratio, CI= Confidence intervals. *Using hierarchical logistic regression analysis with confounding effects of gender, age, smoking, having systemic disease, and taking medications.

Regarding the medical condition, the presence of oral lesions was not significantly different between the participants who suffer medical conditions and those who had no systemic conditions except that participants with cardiac disease were found to have more incidence of geographic tongue (Mann Whitney U test coefficient= 840.0, Z statistic= -1.268, P= .021) and tie tongue (Mann Whitney U test

coefficient= 894.0, Z statistic= -2.183, P= .029) than those who had no cardiac disease as in table (6). Also, the presence of tie tongue was associated with diabetes (Mann Whitney U test coefficient= 2494.0, Z statistic= -2.278, P= .023) and hypertension (Mann Whitney U test coefficient= 2125.0, Z statistic= -2.644, P= .008).

On the other hand, the incidence of oral lesions was not different between those who take or do not take medications except that taking anti-hypertensives was associated with more incidence of geographic tongue (Mann Whitney U test coefficient= 1759.5, Z statistic= -2.072, P= .038) as in table (6). Also, taking anticoagulants was associated with the presence of more geographic tongue (Mann Whitney U test coefficient= 1591.5, Z statistic= -2.289, P= .022) as shown in table (6).

The hierarchical logistic regression analysis demonstrated that older age, smoking, suffering diabetes, taking antidiabetics, taking anticoagulants and having dentures were able to predict and increased the odds of the presence of fissured tongue among the study participants ($P < .05$) (Table 7). Also, smoking was found to be predictive of and increased the odds of having hairy tongue and smokers' palate ($P < .05$) (Table 7). In addition, being a male gender and having dentures were predictive of and increased the odds of the presence of Fordyce's granules ($P < .05$) (Table 7). Furthermore, smoking, not suffering diabetes and longer duration of edentulism were predictive of and increased the odds of the presence of leukoedema ($P < .05$) (Table 7).

Discussion

This study aimed to obtain some information on the presence of normal or pathological intra oral mucosal conditions in a population of edentulous patients visiting the removable prosthodontic department at Jordan University Hospital. Some physiological and para-physiological changes of the normal anatomy can easily be misdiagnosed for pathological conditions (13). In addition, this study investigated possible relationships of some mucosal conditions to age, sex, medical conditions, smoking, and the history of edentulism and experience with complete dentures. Similar studies in the literature reported the incidence of mucosal conditions among elderly patients who presented to dental schools (14, 15), denture wearers (16–18), children (19), and among all dental patients attending the teaching dental school (20, 21). The current study intended to examine edentulous patients with or without complete dentures to record the mucosal conditions they present and to have baseline information on their clinical examination.

The results of this study demonstrated that longer edentulism was linked to higher Atwood's ridge classification in the lower jaw (i.e. more bone resorption), using dentures for longer duration, and the use of more dentures in the past. Atwood's classification of edentulous ridges is helpful as the adult mandible is classified into 6 orders of anatomic forms: I, pre-extraction; II, postextraction; III, high, well-rounded residual ridge; IV, knife-edge residual ridge; V, low, well-rounded residual ridge; VI, depressed residual ridge (22). It is documented that residual ridge resorption is more frequently seen in edentulous patients compared to partially dentate and dentate patients (23). Also, denture wearers had significantly more

maxillary and mandibular ridge resorption than non-denture wearers in the same study (23). Severe ridge resorption was mostly seen in patients wearing dentures for more than 5 years, or for longer durations (24, 25).

Smoking was associated with more hairy tongue, frictional keratosis, smokers' palate, and leukoedema than non-smokers as demonstrated by the results of the current study. Smoking and poor oral hygiene are possible etiological factors causing hairy tongue due to deposition of nicotinic derivatives and excessive keratin production on the filiform papillae of the dorsal surface of the tongue (26). Dundar and Ilhan Kal, 2007 reported that 40.7% of Turkish elderly population have oral mucosal lesions which was related to the length of denture use, smoking and gender (27). In one study 2,318 (61.8%) patients were diagnosed with oral lesions associated with tobacco use and wearing dentures, where the third most commonly seen lesion was frictional keratosis (28). There was a statistically significant relation between the tobacco habit and frictional keratosis in the aforementioned study. One can postulate that the effects smoking has on oral mucosa is exacerbated by wearing dentures and the need for meticulous oral and denture hygiene which most smokers might forget about. Another study in Saudi Arabia examined 599 subjects with a mean age of 34.5 years and found a high prevalence of the following oral lesions in tobacco users; hairy tongue, smoker's melanosis, stomatitis nicotina or smoker's palate, frictional keratosis, fissured tongue, and leukodema (29). Despite the young mean age of the sample in the previous study, the oral lesions seen in our sample follow the same order of prevalence in that study especially both samples share the same ethnic origin.

Participants with dentures were associated with denture stomatitis and denture fissuratum, and had less frictional keratosis than participants without dentures. This was in accordance with a study where records of 380 denture wearers were reviewed, the second most common denture related mucosal lesion was denture-induced stomatitis (30). Another study examined 153 old denture wearers; their results showed that patients who had denture stomatitis and traumatic ulcers were statistically significantly older than patients with no lesions. The length of denture usage was the main factor influencing the appearance of lesions (2). Although the results of the current study did not analyse the significance of the duration of using dentures or the number of old dentures on mucosal lesions, denture stomatitis and denture fissuratum (or denture induced hyperplasia) are the most common here because the majority of denture wears in our sample had one or two previous dentures. One may speculate that having previous dentures may be considered a factor for more denture related mucosal lesions. The relationship between denture wearing and frictional keratosis as shown by the results here is difficult to explain especially that a number of studies demonstrated an increase in the incidence of fibrous hyperplasia with denture usage (31, 32).

Females had less Fordyce's granules, frictional keratosis, smoker palate, and leukoedema than males. Interestingly, an association between non-polyposic colorectal carcinoma syndrome known as (Lynch syndrome) and the Fordyce granules was reported, (33). Therefore, careful examination of Fordyce granules, especially located in lower gingival and vestibular mucosa, may identify families at risk of this carcinoma syndrome (13). However, no association was reported to age or gender or dental status of

patients (13). With regards to leukoedema, it is a benign variation of normal anatomy commonly seen in 90% of black individuals and rarely found in Caucasians, distinguished from leucoplakia as it disappears when the cheek is stretched (13) and so does not require treatment (34). In a study where oral lesions of 969 denture wearers were compared to non-denture wearers; a statistically significant relation was found between candidiasis, traumatic ulceration and frictional keratosis among those who wore dentures (28). Frictional keratosis was more commonly seen in females in the previous study which contradicts with the results here, may be due to the fewer number of females enrolled in our study. However, females had less frictional keratosis than men in another study on denture wearers which supports our results (30).

Regarding the medical condition, the presence of oral lesions was not significantly different between the participants who suffer medical conditions and those who had no systemic conditions except that participants with cardiac disease were found to have more incidence of geographic tongue and tongue tie. Also tongue tie was associated with diabetes and hypertension. Furthermore, the results demonstrated that taking anti-hypertensives and anti-coagulants was associated with more incidence of geographic tongue. This fact is supported by the literature where an association was reported between geographic tongue and patients using more anti-hypertensive medications and among older males (35) as hypertension is commonly linked to cardiac disease. Diabetes, psoriasis, and hormonal changes are other systemic conditions described as possibly seen with geographic tongue (13).

The statistical analysis demonstrated that older age, smoking, being diabetic, taking antidiabetics, taking anticoagulants and having dentures increased the presence of fissured tongue. The fissured tongue is a very common condition seen in 2–5% of the adult population which has a hereditary background and can appear at any age (13).

Being a male and using dentures were predictive of the presence of Fordyce's granules. Furthermore, smoking, not suffering diabetes and longer duration of edentulism were also predictive of leukoedema.

The results of this study found that the edentulous patients attending Jordan University Hospital are in a good state of oral mucosal health, and thank goodness the incidence of dangerous OMCs (leucoplakia and oral malignancies) was zero among the study sample. However, further studies are required to identify the relationship between some systemic conditions such as diabetes and hypertension with the OMCs seen on the tongue (fissured tongue and tongue tie).

Limitations of this study include the limited number of patients due to the COVID-19 pandemic and the reduction in patients attending the student dental clinics. However, the required sample size was determined according to the power calculation and significance levels.

Conclusions

Mucosal changes with increased age, smoking, medical conditions, and medications may be superimposed by wearing complete dentures. Some physiological, para-physiological, or pathological changes of the normal anatomy cannot be easily diagnosed. Therefore, knowledge of the common

mucosal lesions that present in a sample of edentulous patients is very helpful to look after those individuals. The present study demonstrated that there was a relationship between different factors (such as gender, smoking, age, systemic diseases, using dentures) and the incidence of some OMCs (such as Fordyce's granules, geographic tongue, fissured tongue, frictional keratosis, and denture stomatitisetc.).

Declarations

Ethics approval and consent to participate:

Ethical approval was sought from the ethics committee at Jordan University Hospital. Informed consent was obtained from the patients to participate in the study. No rewards were given to participants.

Consent for publication:

Informed consent for publication was obtained from participants.

Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

Funding:

No funds were received.

Authors' contributions:

S.S. developed the methods and wrote the main manuscript (also the corresponding author); Y.H. put the main concept and reviewed and edited the manuscript; D.A. collected the data; examined and interviewed the patients; N.S. and S.A. helped in data collection and manuscript review. All authors read and approved the final manuscript.

Acknowledgements:

Not applicable.

References

1. Al-Maweri SA, Al-Jamaei AA, Al-Sufyani GA, Tarakji B, Shugaa-Addin B. Oral mucosal lesions in elderly dental patients in Sana'a, Yemen. *Journal of International Society of Preventive & Community*

- Dentistry. 2015 May;5(Suppl 1):S12-9. PubMed PMID: 25984462. Pubmed Central PMCID: PMC4428014. Epub 2015/05/20. eng.
2. Mandali G, Sener ID, Turker SB, Ülgen H. Factors affecting the distribution and prevalence of oral mucosal lesions in complete denture wearers. *Gerodontology*. 2011;28(2):97–103.
 3. Peracini A, Andrade IMd, Paranhos HdFO, Silva CHLd, Souza RFd. Behaviors and hygiene habits of complete denture wearers. *Brazilian dental journal*. 2010;21:247–52.
 4. Espinoza I, Rojas R, Aranda W, Gamonal J. Prevalence of oral mucosal lesions in elderly people in Santiago, Chile. *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*. 2003 Nov;32(10):571–5. PubMed PMID: 14632931. Epub 2003/11/25. eng.
 5. Atashrazm P, Sadri D. Prevalence of oral mucosal lesions in a group of Iranian dependent elderly complete denture wearers. *J Contemp Dent Pract*. 2013 Mar 1;14(2):174-8. PubMed PMID: 23811641. Epub 2013/07/03. eng.
 6. Coelho CM, Sousa YT, Daré AM. Denture-related oral mucosal lesions in a Brazilian school of dentistry. *J Oral Rehabil*. 2004 Feb;31(2):135–9. PubMed PMID: 15009597. Epub 2004/03/11. eng.
 7. Freitas JB, Gomez RS, De Abreu MH, Ferreira EFE. Relationship between the use of full dentures and mucosal alterations among elderly Brazilians. *J Oral Rehabil*. 2008 May;35(5):370–4. PubMed PMID: 18405273. Epub 2008/04/15. eng.
 8. Jainkittivong A, Aneksuk V, Langlais RP. Oral mucosal conditions in elderly dental patients. *Oral Dis*. 2002 Jul;8(4):218–23. PubMed PMID: 12206403. Epub 2002/09/11. eng.
 9. Turker SB, Sener ID, Koçak A, Yilmaz S, Ozkan YK. Factors triggering the oral mucosal lesions by complete dentures. *Arch Gerontol Geriatr*. 2010 Jul-Aug;51(1):100–4. PubMed PMID: 19819567. Epub 2009/10/13. eng.
 10. Sghaireen MG. Oral mucosal lesions among complete denture patients. *Indian Journal of Stomatology*. 2015;6(2).
 11. Mathew AL, Pai KM, Sholapurkar AA, Vengal M. The prevalence of oral mucosal lesions in patients visiting a dental school in Southern India. *Indian Journal of Dental Research*. 2008;19(2):99.
 12. Kramer IR, Pindborg JJ, Bezroukov V, Infirri JS. Guide to epidemiology and diagnosis of oral mucosal diseases and conditions. World Health Organization. *Community dentistry and oral epidemiology*. 1980 Feb;8(1):1–26. PubMed PMID: 6929240. Epub 1980/02/01. eng.
 13. della Vella F, Lauritano D, Lajolo C, Lucchese A, Di Stasio D, Contaldo M, et al. The Pseudolesions of the Oral Mucosa: Differential Diagnosis and Related Systemic Conditions. *Applied Sciences*. 2019;9(12):2412. PubMed PMID: doi:10.3390/app9122412.
 14. Rohini S, Sherlin HJ, Jayaraj G. Prevalence of oral mucosal lesions among elderly population in Chennai: a survey. *Journal of Oral Medicine and Oral Surgery*. 2020;26(1):10.
 15. Shet R, Shetty SR, Kalavathi M, Naveen Kumar M, Yadav RD, Soumya S. A study to evaluate the frequency and association of various mucosal conditions among geriatric patients. *J Contemp Dent Pract*. 2013;14(5):904–10.

16. Martori E, Ayuso-Montero R, Martinez-Gomis J, Viñas M, Peraire M. Risk factors for denture-related oral mucosal lesions in a geriatric population. *The Journal of prosthetic dentistry*. 2014;111(4):273–9.
17. Turker SB, Sener ID, Koçak A, Yılmaz S, Özkan YK. Factors triggering the oral mucosal lesions by complete dentures. *Archives of gerontology and geriatrics*. 2010;51(1):100–4.
18. Coelho C, Sousa Y, Dare A. Denture-related oral mucosal lesions in a Brazilian school of dentistry. *Journal of oral rehabilitation*. 2004;31(2):135–9.
19. Majorana A, Bardellini E, Flocchini P, Amadori F, Conti G, Campus G. Oral mucosal lesions in children from 0 to 12 years old: ten years' experience. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2010;110(1):e13-e8.
20. Chiang M-L, Hsieh Y-J, Tseng Y-L, Lin J-R, Chiang C-P. Oral mucosal lesions and developmental anomalies in dental patients of a teaching hospital in Northern Taiwan. *Journal of Dental Sciences*. 2014;9(1):69–77.
21. El Toum S, Cassia A, Bouchi N, Kassab I. Prevalence and distribution of oral mucosal lesions by sex and age categories: A retrospective study of patients attending lebanese school of dentistry. *International journal of dentistry*. 2018;2018.
22. Atwood DA. Postextraction changes in the adult mandible as illustrated by microradiographs of midsagittal sections and serial cephalometric roentgenograms. *The Journal of Prosthetic Dentistry*. 1963 1963/09/01/;13(5):810–24.
23. Imirzalioglu P, Yuzugullu B, Gulsahi A. Correlation between residual ridge resorption and radiomorphometric indices. *Gerodontology*. 2012;29(2):e536-e42.
24. Alsaggaf A, Fenlon MR. A case control study to investigate the effects of denture wear on residual alveolar ridge resorption in edentulous patients. *Journal of dentistry*. 2020;98:103373.
25. Al-Jabrah O, Al-Shumailan Y. Association of complete denture wearing with the rate of reduction of mandibular residual ridge using digital panoramic radiography. *Int J Dent Res*. 2014;2(1):20–5.
26. Gurvits GE, Tan A. Black hairy tongue syndrome. *World journal of gastroenterology*. 2014 Aug 21;20(31):10845-50. PubMed PMID: 25152586. Pubmed Central PMCID: PMC4138463. Epub 2014/08/26. eng.
27. Dundar N, Ilhan Kal B. Oral mucosal conditions and risk factors among elderly in a Turkish school of dentistry. *Gerontology*. 2007;53(3):165–72. PubMed PMID: 17202819. Epub 2007/01/05. eng.
28. Patil S, Yadav N, Patil P, Kaswan S. Prevalence and the relationship of oral mucosal lesions in tobacco users and denture wearers in the North Indian population. *J Family Community Med*. 2013;20(3):187–91. PubMed PMID: 24672277. eng.
29. Al-Attas SA, Ibrahim SS, Amer HA, Darwish ZE-S, Hassan MH. Prevalence of potentially malignant oral mucosal lesions among tobacco users in Jeddah, Saudi Arabia. *Asian Pacific Journal of Cancer Prevention*. 2014;15(2):757–62.
30. Jainkittivong A, Aneksuk V, Langlais RP. Oral mucosal lesions in denture wearers. *Gerodontology*. 2010;27(1):26–32.

31. FREITAS JB, GOMEZ RS, DE ABREU MHNG, FERREIRA E FERREIRA E. Relationship between the use of full dentures and mucosal alterations among elderly Brazilians. *Journal of Oral Rehabilitation*. 2008;35(5):370–4.
32. Pentenero M, Broccoletti R, Carbone M, Conrotto D, Gandolfo S. The prevalence of oral mucosal lesions in adults from the Turin area. *Oral Diseases*. 2008;14(4):356–66.
33. De Felice C, Parrini S, Chitano G, Gentile M, Dipaola L, Latini G. Fordyce granules and hereditary non-polyposis colorectal cancer syndrome. *Gut*. 2005 Sep;54(9):1279–82. PubMed PMID: 15879014. Pubmed Central PMCID: PMC1774669. Epub 2005/05/10. eng.
34. Felix DH, Luker J, Scully PC. Oral medicine: 6. white lesions. *Dental Update*. 2013;40(2):146–54. PubMed PMID: 23600041.
35. Dafar A, Çevik-Aras H, Robledo-Sierra J, Mattsson U, Jontell M. Factors associated with geographic tongue and fissured tongue. *Acta odontologica Scandinavica*. 2016;74(3):210–6. PubMed PMID: 26381370. Epub 2015/09/19. eng.

Figures

Tongue conditions:

Fissured tongue

Geographic tongue

Hairy tongue (Oral candidiasis)

Median rhomboid glossitis

Sublingual varices

Leukoplakia

Cheeks:

Fordyce granules

Frictional keratosis

Lichen planus

Palate:

Smoker's palate

Denture stomatitis

Oral mucosa:

Leukoedema

Leukoplakia

Oral candidiasis

Aphthous stomatitis

Oral submucous fibrosis

Oral malignancies

Denture fissuratum

Irritational fibroma

Angular cheilitis

Herpes labialis

Mucocele

Figure 1

The sequence of mucosal tissues examination according to Mathew et al. 2008 (11).