Alqalam Journal of Medical and Applied Sciences. 2025;8(1):1-6
https://doi.org/10.54361/ajmas.258101

Original article

Prevalence and Trends of Oral Diseases in Elderly Patients at Tripoli University Hospital: A 20-Year Retrospective Analysis

Eman Aga*, Ebtesam Aldieb

Department of Oral Medicine, Oral Pathology, and Oral & Maxillofacial Surgery, Faculty of Dentistry, University of Tripoli, Tripoli, Libya

Corresponding Email. e.aga@uot.edu.ly

Abstract

It is now well recognized that there has been a revolution in the age pyramid of many societies, and within a very short time, there will be more people over 60. This is because of a considerable increase in the expectation of life. The current study evaluated retrospectively the frequency and prevalence of elderly patients' lesions recorded from the Pathology Department and Oral Maxillofacial Department database of Tripoli University Hospital, Tripoli, Libya from 2002 to 2022 year. The total number of reports was 2366 biopsies. The cross-sectional study included patients aged 60 and over. An oral and maxillofacial pathologist revised all histopathologic diagnoses. The study used SPSS version 25 software for data management, and analysis, employed basic descriptive statistics and bivariate analysis to examine the relationship between oral lesions prevalence and demographic factors like age and gender, with a p-value of <0.05. The percentage of oral and maxillofacial lesions in older patients during the period 2002 to 2022 was approximately 7.4%. Regarding gender distribution, 50.9% of the patients were male and 49.1% were female. The average age for females was 68.33 ± 6.449 years, and for males, it was 68.28 ± 7.399 years. Inflammatory lesions were the most common (40.7%) of the cases. Followed by autoimmune diseases (13.9%) while odontogenic cysts, salivary gland disease, and malignant tumors showed the same percentage (9.3%). According to the study's findings on the frequency of oral lesions in geriatrics. Knowledge of clinical signs and histopathology of oral cavity disease is necessary for prevention, early diagnosis, and correct treatment plan.

Keywords. *Elderly Patients, Pathology, Biopsy, Oral Lesions.*

Introduction

One of the biggest threats to modern public health is the aging population, particularly in developing nations where there is extreme social disparity and extreme poverty [1,2]. The World Health Organization (WHO) in 1984 declared individuals 60 years or older as elderly [3]. As individuals age, their oral cavity becomes more vulnerable to oral lesions (4). In the last few decades, the percentage of older individuals is expected to rise globally from 10.5% in 2007 to 21.8% in 2050, according to projections made by the World Health Organization (WHO) [5,6].

General health and any illness are reflected in one's oral health; for these reasons, improving oral health will have an impact on overall health and age groups that are at risk [7]. Moreover, elderly people's general health is a significant concern that is closely linked to their dental health. It makes sense to say that the oral cavity is "the mirror" of one's health. Oral mucosal alterations can indicate a variety of general medical conditions. Such as diabetes, blood disorders, skin conditions, immunological deficits, allergic and poisonous responses, stomach disorders, and insufficiencies in vitamins and minerals [6]. Elderly people frequently experience dental caries and other oral and dental issues. These issues include thinning and dry mouth mucosa, taste loss, a glossy and smooth tongue, decreased oral tissue repair, infection, improper artificial teeth, benign and malignant oral lesions, and bone resorption [8].

Even though there is a lot of research on oral diseases in the older population worldwide, most of it relies more on clinical presentation than histological diagnosis. To suggest the optimal course of treatment for a disease, a histopathologic diagnosis is necessary since the histopathologic examination is regarded as the gold standard for diagnosing such lesions [4,9,10]. Data on oral mucosal conditions prevalent among the elderly Libyan population are sparse. This study aimed to review the oral biopsies reported in the Tripoli University Hospital over the last 20 years and to examine the trends in geriatric oral pathologies.

Methods

A cross-sectional analysis was adopted in this study, suing biopsy records from the pathology department and oral maxillofacial department database of Tripoli University Hospital from 2002 to 2022. The total number of reports was 2366 biopsies included patients aged 60 and over. An oral and maxillofacial pathologist revised all histopathologic diagnosis information about age, gender, lesion location, and type of oral lesions. The study was excluded patients below 60 years, incomplete or missing biopsy records, and records outside the specified study period.

A structured data collection form was used to extract relevant information. The lesions were classified into nine diagnostic categories depending on the definitive diagnosis and biological behavior of the lesions and taking in consideration the classification of previous studies. The study used SPSS version 25 software for

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received: *30-10-2024* - ***Accepted***: *26-12-2024* - ***Published***: *01-01-2025*

data management and analysis, employed basic descriptive statistics and bivariate analysis to examine the relationship between oral lesions prevalence and demographic factors like age and gender, with a p-value of <0.05.

Results

From 2366 biopsies at the archive, 175 biopsies (7.4%), 67 undiagnosed cases were excluded, resulting in 108 cases being included in the study. Regarding gender distribution, 50.9% of the patients were male and 49.1% were female. The ages of the patients included in the study ranged from 60 to 95 years. The average age for females was 68.33 ± 6.449 years, and for males, it was 68.28 ± 7.399 years. Most patients (58.3%) were in the 60-69 age group. The 70-79 age group represented 33.3% of the total, and the remaining 8.3% of the patients were aged 80 and above (Table 1).

Table 1. Demographic characteristics of study participants

Item		Frequency	Percentage
Sex	Male	55	50.9%
	Female	53	49.1%
Age category (year)	60 -69	63	58.3%
	70 -79	36	33.3%
	80+	9	8.3%

The distribution of oral diseases in elderly patients, based on a study of 108 cases, shows several significant trends. Malignant tumors were found in 10 cases (9.3%). Benign tumors were present in 6 cases, representing 5.6% of the total. Inflammatory lesions were the most common, observed in 44 cases, which constitutes 40.7% of the cases. Salivary gland diseases and odontogenic cysts were each found in 10 cases, both accounting for 9.3% of the cases. Reactive lesions were diagnosed in 8 cases, representing 7.4% of the total. Autoimmune diseases were noted in 15 cases, comprising 13.9% of the cases. Infections were relatively rare, with 3 cases or 2.8% of the total. Premalignant conditions were the least frequent, with 2 cases making up 1.9% of the cases (Figure 1).

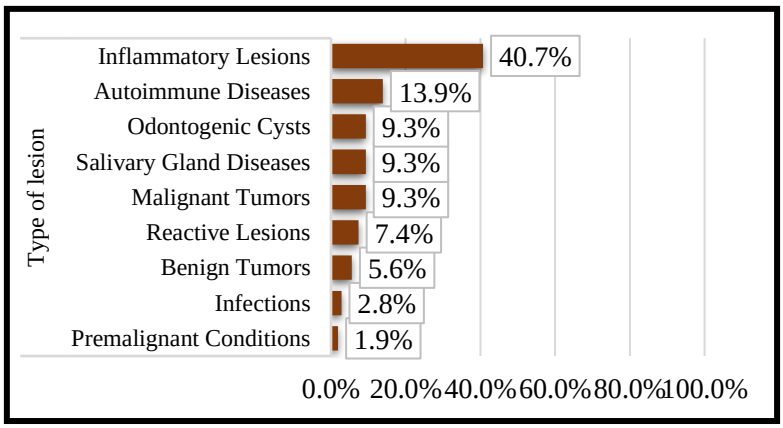

Figure 1. Distribution of oral diseases in elderly patient

Table 2 revealed the distribution of oral diseases by sex among elderly patients shows distinct trends. Malignant tumors were more common in males (14.5%) *versus* 2 in females (3.8%). Benign tumors appeared in 4 males (7.3%) and 2 females (3.8%). Females had a higher incidence of inflammatory lesions 24 (45.3%) compared to males 20 (36.4%). Salivary gland diseases were identified in 6 males (10.9%) and 4 females (7.5%), while odontogenic cysts were found in 6 males (10.9%) and 4 females (7.5%). Reactive lesions occurred equally in both sexes, with 4 (7.3%) in males and 4 (7.5%) in females. Autoimmune diseases were predominantly found in females, 11 (20.8%) versus males' 4 (7.3%). Males had a slightly higher occurrence of infections 2 (3.6%) than females 1 (1.9%). Premalignant conditions were found to be equally common in both sexes, with 1 (1.8%) in males and 1 (1.9%) in females. According to the Pearson Chi-Square test results (Chi-square = 8.99, P value = 0.343), no statistically significant correlation exists between sex and the type of oral disease diagnosed.

Distribution of Oral Diseases among age groups was presented in table 3. Inflammatory lesions were most common in the 60-69 age group with 22 cases (34.9%), followed by the 70-79 age group with 15 cases (23.8%), and the 80+ age group, with 7 cases (19.4%) and premalignant lesion represent the least cases and same percentage. Premalignant conditions were found equally in the 60-69 age group, with 1 case (1.6%), and in the 70-79 age group, with 1 case (2.8%). In the 80+ age group, all lesions except inflammatory and autoimmune disease showed no cases. The results of the Pearson Chi-Square test (Chi-square = 11.06, P

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received*: 30-10-2024 -* ***Accepted****: 26-12-2024 -* ***Published****: 01-01-2025*

https://doi.org/10.54361/ajmas.258101

value = 0.806) suggest that there is no statistically significant correlation between age group and the type of oral disease.

Table 2. Sex distribution of oral diseases among elderly patients

Type of Disease	Male		Female	
	N	%	N	%
Malignant Tumors	8	14.5%	2	3.8%
Benign Tumors	4	7.3%	2	3.8%
Inflammatory Lesions	20	36.4%	24	45.3%
Salivary Gland Diseases	6	10.9%	4	7.5%
Odontogenic Cysts	6	10.9%	4	7.5%
Reactive Lesions	4	7.3%	4	7.5%
Autoimmune Diseases	4	7.3%	11	20.8%
Infections	2	3.6%	1	1.9%
Premalignant Conditions	1	1.8%	1	1.9%
Pearson Chi-Square Tests (Chi-square = 8.99, P value = 0.343)				

Table 3. Age distribution of oral diseases among elderly patients

Type of lesion	60 -69 year		70 -79 year		80 years or older	
	N	%	N	%	N	%
Malignant Tumors	8	12.7%	2	5.6%	0	0.0%
Benign Tumors	4	6.3%	2	5.6%	0	0.0%
Inflammatory Lesions	22	34.9 %	15	23.8 %	7	19.4%
Salivary Gland Diseases	5	7.9%	5	13.9%	0	0.0%
Odontogenic Cysts	7	11.1%	2	5.6%	1	11.1%
Reactive Lesions	6	9.5%	2	5.6%	0	0.0%
Autoimmune Diseases	8	12.7%	6	16.7%	1	11.1%
Infections	2	3.2%	1	2.8%	0	0.0%
Premalignant Conditions	1	1.6%	1	2.8%	0	0.0%
Pearson Chi-Square test (Chi-square = 11.06, P value = 0.806)						

Over the past 20 years, the prevalence of oral diseases has seen significant changes. Malignant tumors, which accounted for 3.9% of total cases between 2003 and 2012, increased significantly from 4 cases in 2003 to 7 cases in 2022, indicating a growing concern. Benign tumors, which remained relatively low but slightly increased, accounted for 9.4% of total cases in the latter period. Inflammatory lesions are the most frequent condition in the first decade. Salivary gland diseases saw a notable decline, with no reported cases from 2013 to 2022. Odontogenic cysts remained relatively stable, with a slight percentage increase. Reactive lesions increased, accounting for 12.5% of total cases. Autoimmune diseases accounting 14.5% in the first decade and 12.5% in the second decade. Infections increased in prevalence, with 1 case from 2003 to 2012 and 2 cases from 2013 to 2022. Premalignant conditions were reported in 2 cases from 2003 to 2012, but no cases were reported from 2013 to 2022. The Pearson Chi-Square test indicates that there is a statistically significant difference in the distribution of disease types between the two time periods (P value =0.013) (Table 4).

Table 4. Distribution of disease types by years

Type of lesion	(2003- 2012)		(2013-2022)	
	N	%	N	%
Malignant Tumors	3	3.9%	7	21.9%
Benign Tumors	3	3.9%	3	9.4%
Inflammatory Lesions	35	46.1%	9	28.1%
Salivary Gland Diseases	10	13.2%	0	0.0%
Odontogenic Cysts	7	9.2%	3	9.4%
Reactive Lesions	4	5.3%	4	12.5%
Autoimmune Diseases	11	14.5%	4	12.5%
Infection	1	1.3%	2	6.3%
Premalignant Conditions	2	2.6%	0	0.0%
Pearson Chi-Square test (Chi-square = 19.46, P value = 0.013)				

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received*: 30-10-2024 -* ***Accepted****: 26-12-2024 -* ***Published****: 01-01-2025*

Discussion

Because of the complexity of systemic problems linked to aging, older people may exhibit a variety of Oro-facial abnormalities [11]. Clinicians can prescribe the most appropriate course of treatment when a biopsy is used to make a definitive and accurate diagnosis of a lesion that appears as a suspicious swelling, ulcer, or white lesion. Important information about the prevalence of lesions that frequently affect a certain group can be obtained by compiling biopsy-based data.

At the general pathology department of Tripoli university hospital, the percentage of oral and maxillofacial lesions in older patients during the period 2002 to 2022 was approximately 7.4 % taking into consideration some missing data. In other research, however, Pardis et al [9], Cunha et al [12] and Souza et al [1] respectively have slightly high prevalence rates of geriatric patients (17.7%-23.1%-31.1%). This variation may relate to Genetic and geographic variations, oral habits, study duration, and age range all contribute to the varying occurrence of oral biopsies in older people.

We observed that lesions in males (50.9%) were slightly more than in females (49.1%) which is approximately similar to those reported in other studies in Isfahan, Iran, Zahedan, Iran, and Saudi Arabian [2,4,13]. In contrast, other epidemiological studies [11,12,14,15] showed that there were more female than male patients, while Sohal et al in Tanzania [16] demonstrated that the ratio of female to male was equal. This variation may be related to many factors like demographic, cultural, social, and geographic factors [12]. In the present study, most of the patients ranged from 60 to 69 years. The average age for females was 68.33 ± 6.449 years, and for males, it was 68.28 ± 7.399 years which is approximately in line with most previous studies [9,11-14].

Concerning the prevalence of oral conditions in the elderly Comprising 40.7% of the cases, inflammatory lesions were the most prevalent, which is in agreement with the study in Iran [15]. Autoimmune disease represents the second proportion of all lesions with 13.9%, odontogenic cysts, salivary gland disorders, and malignant tumors accounted for 9.3% of the cases. Infections accounted for 2.8% of the total, reactive lesions for 7.4%, and benign tumors for 5.6%. The least common condition, accounting for 1.9% of the cases, was premalignant. On the contrary other studies found the most prevalent diagnosis was inflammatory and reactive lesions [10,12,17,18]. Qannam et al [13] in Saudi reported that reactive lesions were most diagnosed and Frizzerin et al [19] established that immunological disease was predominant.

Furthermore, the findings of studies performed by Souza et al. [1] and Carvalho et al. [20] found fibrous dysplasia, a non-neoplastic proliferative disease was most prevalent (24%), (19.1%) respectively, and Correa et al. [21] in Brazil found inflammatory fibrous hyperplasia, squamous cell carcinoma, and fibroma. While Sohal et al. [16] in Tanzania and Fattori et al. [14] in Brazil southern. This may be explained by the greater use of removable dentures by the older population. Sarvani et al. [4] in Iran, Dhanuthai et al. [10] in Thailand, and Lei et al. [18] in Taiwan reported that the majority of the lesions were malignant. On the other hand, Pardis et al [9] showed the most common lesion was autoimmune disease (21.6%). This variation could be explained due to the different methodologies used by different researchers and most population-based studies focused on oral mucosal lesions with oral cancer and precancerous conditions**.**

Our finding was that there was no significant correlation between sex and the type of oral disease diagnosed (P value = 0.343). Malignant tumors were more common in males, 8(14.5%) this high prevalence of malignant lesions in men was explained by some studies of high consumption of tobacco and alcohol [22]. Women had a higher incidence of inflammatory lesions, with 24(45.3%), which is approximately similar to [12] where the most cases affected females were inflammatory and reactive lesions. On the other hand, autoimmune diseases were predominantly found in females, (20.8%), this may be explained by women having a high risk for autoimmune disease.

In the current work, there was no significant difference in the relation between age groups, most lesions were observed in the 60-69 years and least in ≤ 80 which is in agreement with the other studies [4,9,17]. Inflammatory lesions were most common in all age groups, with 34.9%, 23.8%, and 19.4% respectively followed by Autoimmune disease while premalignant conditions showed less frequent. This is in contrast to the results of other studies, Maleki et al. [2] revealed that malignant tumors were the most pathologic lesions in all age groups. While Cunha et al. [12] demonstrated that the most common diseases were inflammatory and reactive lesions. Later decades saw a decline in the frequency of oral lesions, which was in line with another research [2,9,10,18,21]. These findings may be explained by the main causes of the decline in oral biopsies in very elderly patients including neglecting oral lesions and failing to refer to medical centers.

Finally, in the current work, we observed a significant distribution between disease categories and periods. Where the majority of lesions are in the first decade. Inflammatory accounted for the most disease (46.15%). Contrarily, malignant tumors, which accounted for (3.9%) between 2003 and 2012, increased significantly to (21,9%) in the last ten years, which may be explained by the high exposure of people in this area to carcinogenic substances as a result of war, pollution and nonhealthy lifestyle. Furthermore, Infections increased in prevalence from (1.6%) to (6.3%) and salivary gland diseases saw a notable decline, with no reported cases in recent decades. Another study by Maleki et al. [2] reported no significant relation between the frequency of lesions and decades. Where the majority of diseases (55.6%) were related to the last ten years.

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received*: 30-10-2024 -* ***Accepted****: 26-12-2024 -* ***Published****: 01-01-2025*

Conclusion

In summary, the purpose of this study was to determine the prevalence of oral maxillofacial disorders in old people. According to the study's findings, the most frequent lesion identified by histopathologic diagnosis was inflammatory. Additional epidemiological surveys and additional hospital-based research would help determine how oral lesions develop differently in elderly individuals in various climates

Acknowledgments

The authors thank the General Pathology Department and Oral Maxillofacial Department of Tripoli University Hospital for supporting and approving this research.

Conflicts of Interest

There are no financial, personal, or professional conflicts of interest to declare.

References

1. Souza S, Alves T, Santos J, Oliveira M. Oral lesions in elderly patients in referral centers for oral lesions of Bahia. International archives of otorhinolaryngology. 2015;19(04):279-85.
2. Maleki L, Kargahi N, Hatefi SE. Evaluation of oral pathologic lesions in elderly patients in Isfahan, Iran, 1989-2018 years. Brazilian Dental Science. 2021;24(1):5 p.- p.
3. Cueto A, Martínez R, Niklander S, Deichler J, Barraza A, Esguep A. Prevalence of oral mucosal lesions in an elderly population in the city of Valparaiso, Chile. Gerodontology. 2013;30(3):201-6.
4. Saravani S, Moudi M, Kadeh H, Tavakoli Amin M. Epidemiological Study of Oral and Maxillofacial Biopsies from Geriatric Patients in Zahedan, Iran (1996-2015). Journal of Dental Materials & Techniques. 2016;5(4).
5. Bakhshi M, Hassani Z, Tofangchiha M, Baharvand M. Frequency of oral anatomic variations and mucosal lesions among a defined group of elderly dental patients in Iran. Biotechnology and Health Sciences. 2015.
6. Radwan-Oczko M, Bandosz K, Rojek Z, Owczarek-Drabińska JE. Clinical study of oral mucosal lesions in the elderly—Prevalence and distribution. International journal of environmental research and public health. 2022;19(5):2853.
7. Cheruvathoor DD, Thomas V, Kumar NR, Jose M. High prevalence of oral mucosal lesions in elderly: Call for revolutionizing geriatric dental care strategies. Journal of Family Medicine and Primary Care. 2020;9(8):4375-80.
8. Shet R, Shetty SR, Kalavathi M, Kumar MN, 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.
9. Pardis S, Taheri MM, Fani MM. Oraland Maxillofacial Lesions in an Elderly Population in Shiraz, Iran. 2014.
10. Dhanuthai K, Rojanawatsirivej S, Somkotra T, Shin HI, Hong SP, Darling M, et al. Geriatric oral lesions: a multicentric study. Geriatrics & Gerontology International. 2016;16(2):237-43.
11. Akinshipo A, Akinyamoju A, Soyele O, Effiom O, Adeyemo W. Epidemiological study of histologically diagnosed oral and maxillofacial lesions in a Nigerian geriatric population. 2018.
12. Cunha JLS, Cavalcante IL, Rodrigues ABR, CATÃO NEdS, Cruz VMS, Turatti E, et al. A retrospective multicenter study of oral and maxillofacial lesions in older people. Brazilian Oral Research. 2023;37:e098.
13. Qannam A, Bello I. The range of diagnoses for oral soft-tissue biopsies of geriatric patients in a Saudi Arabian teaching hospital. Saudi Dent J. 2016; 28 (2): 96-101.
14. Fattori E, Cherubini K, Salum F-G. Stomatological disorders in older people: An epidemiological study in the Brazil southern. Medicina Oral, Patología Oral y Cirugía Bucal. 2019;24(5):e577.
15. Muzyka B, Dehler K, Brannon R. Characterization of oral biopsies from a geriatric population. General dentistry. 2009;57:432-7.
16. Sohal KS, Kalyanyama BM, Agbor AM. Analysis of 358 histopathological reports of oral and maxillofacial lesions in elderly patients from Tanzania: a cross-sectional study. Annals of Medicine and Surgery. 2023;85(5):1655-60.
17. Silva LP, Leite RB, Sobral AP, Arruda JA, Oliveira LV, Noronha MS, et al. Oral and maxillofacial lesions diagnosed in older people of a brazilian population: a multicentric study. Journal of the American Geriatrics Society. 2017;65(7):1586-90.
18. Lei F, Chen JY, Wang WC, Lin LM, Huang HC, Ho KY, et al. Retrospective study of oral and maxillofacial lesions in older T aiwanese patients. Gerodontology. 2015;32(4):281-7.
19. Frizzerin C, Alberton G, Rushiti A, Bacci C. Oral Pathology in the Elderly: Prevalence in a Hub Hospital. 2023.
20. de Vasconcelos Carvalho M, Iglesias DPP, do Nascimento GJF, Sobral APV. Epidemiological study of 534 biopsies of oral mucosal lesions in elderly Brazilian patients. Gerodontology. 2011;28(2):111-5.
21. Corrêa L, Frigerio MLMA, de Sousa SCOM, Novelli MD. Oral lesions in elderly population: a biopsy survey using 2250 histopathological records. Gerodontology. 2006;23(1):48-54.
22. Patil S, Doni B, Maheshwari S. Prevalence and distribution of oral mucosal lesions in a geriatric Indian population. Can Geriatr J. 2015;18(1):11-4.

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received*: 30-10-2024 -* ***Accepted****: 26-12-2024 -* ***Published****: 01-01-2025*

https://doi.org/10.54361/ajmas.258101

المستخلص

لقد أصبح من المعترف به الآن أن هناك ثورة في الهرم العمري للعديد من المجتمعات، وخلال فترة قصيرة جدًا، سيكون هناك المزيد من الأشخاص الذين تزيد أعمارهم عن 60 عامًا. ويرجع ذلك إلى الزيادة الكبيرة في توقعات الحياة. قامت الدراسة الحالية بتقييم بأثر رجعي تواتر وانتشار آفات المرضى المسنين المسجلة من قسم علم الأمراض وقاعدة بيانات قسم الوجه والفكين في مستشفى جامعة طرابلس، طرابلس، ليبيا من عام 2002 إلى عام 2022. وبلغ العدد الإجمالي للتقارير 2366 خزعة. وشملت الدراسة المقطعية المرضى الذين تتراوح أعمارهم بين 60 وما فوق. قام أخصائي أمراض الفم والوجه والفكين بمراجعة جميع التشخيصات التشريحية المرضية. استخدمت الدراسة الإصدار 25 من برنامج SPSS لإدارة البيانات وتحليلها، واستخدمت الإحصائيات الوصفية الأساسية والتحليل ثنائي المتغير لفحص العلاقة بين انتشار الآفات الفموية والعوامل الديموغرافية مثل العمر والجنس، بقيمة $p < 0.05$. بلغت نسبة آفات الفم والوجه والفكين لدى المرضى الأكبر سناً خلال الفترة من 2002 إلى 2022 حوالي 7.4%. وفيما يتعلق بالتوزيع حسب الجنس، فإن 50.9% من المرضى ذكور و49.1% إناث. وكان متوسط العمر للإناث 68.33 ± 6.449 سنة، وللذكور 68.28 ± 7.399 سنة. وكانت الآفات الالتهابية الأكثر شيوعا (40.7٪) من الحالات. تليها أمراض المناعة الذاتية (13.9%)، في حين أظهرت الأكياس السنية، وأمراض الغدد اللعابية، والأورام الخبيثة نفس النسبة (9.3%). ووفقا لنتائج الدراسة حول تواتر الآفات الفموية لدى كبار السن. إن معرفة العلامات السريرية والتشريح المرضي لمرض تجويف الفم أمر ضروري للوقاية والتشخيص المبكر وخطة العلاج الصحيحة.

الكلمات الدالة. المرضى المسنين، علم الأمراض، الخزعة، الآفات الفموية.

Copyright *Author (s) 2025. Distributed under Creative Commons CC-BY 4.0*
Received*: 30-10-2024 -* ***Accepted****: 26-12-2024 -* ***Published****: 01-01-2025*