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Original article

Frequency and Demographic Profile of Odontogenic Cysts Diagnosed at Tripoli University Hospital, Libya

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ABSTRACT

Odontogenic cysts are a group of lesions that exclusively affect the oral and maxillofacial regions. The current study aimed to determine the relative frequency and demographic features of odontogenic cysts diagnosed histologically at Tripoli University Hospital and to compare our findings with the latest reports. A 22-year retrospective study of odontogenic cysts histologically diagnosed at Tripoli University Hospital, Tripoli, Libya, archived from 2002 to 2023 was performed. Demographic data including, gender, age at diagnosis, location of lesion, and histopathological diagnosis, were collected and analyzed retrospectively. The diagnosis was according to the latest criteria of the 2022 World Health Organization classification. Odontogenic cysts constituted 9.7% of all 2334 registered orofacial biopsy specimens. A total of 227 cases of histologically diagnosed odontogenic cysts were analyzed. Of these, 129 (56.8%) were inflammatory cysts and 98 (43.2%) were developmental cysts. Apical radicular was the most common type of cyst (54.2%), followed by dentigerous cyst (31.3%), and odontogenic keratocyst (5.3%). A slight male predilection was observed with an overall male-to-female ratio of 1.2:1. The age range was from 5 to 85 years with an overall mean age of 33 ± 15.16 years. The peak incidence was in the third and fourth decades of life. The posterior regions of the jaws were the most prevalent sites (34.4%) for all studied cysts. The demographic profile of the odontogenic cysts in this cohort is similar to previous reports in Libyan and other worldwide populations.

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INTRODUCTION

Odontogenic cysts (OCs) are a group of lesions that exclusively affect the oral and maxillofacial regions, commonly in the jaw bones and rarely in the gingiva. They develop from the epithelial components of the tooth-forming apparatus or its remnants, such as the dental lamina, the epithelial rests of Malassez, or the enamel organ. There are two major groups of OCs based on their origin: inflammatory cysts are associated with inflammation, while developmental cysts are of unknown etiology [1,2].

Despite OCs being considered benign lesions, neoplastic proliferation in the epithelial lining of OCs has been reported in the literature [3–5]. Therefore, accurate knowledge about OCs prevalence, demographics, and clinicopathological characteristics is essential for early diagnosis to minimize any necessary surgical treatment [6].

In the last decades, several classifications and modifications have been published by the World Health Organization (WHO) for Head and Neck Tumors. In the third edition of the WHO classification published in 2005 [7], odontogenic keratocysts and calcifying odontogenic cysts were considered odontogenic tumors and named keratocystic odontogenic

tumors and calcifying odontogenic cystic tumors, respectively. Nevertheless, in the fourth edition of the WHO classification published in 2017 [8], keratocystic odontogenic tumors and calcifying odontogenic cystic tumors were re-classified as developmental OCs and named odontogenic keratocysts, and calcifying odontogenic cysts, respectively. Moreover, they remained odontogenic cysts in the latest fifth edition of the WHO classification published in 2022 [9]. These classifications caused variations in the frequency and prevalence of OCs and tumors, rendering an update of their epidemiology essential [10].

Several published studies have evaluated the prevalence and frequency of OCs in pathology services according to the updating of WHO classification in different geographical regions of the world and the eastern region of Libya, showing the prevalence accounts for 3.9–63.92% of all submitted orofacial biopsy specimens [11–23]. To our knowledge, little information is available in the international literature about the prevalence and frequency of OCs in the western Libyan population [24,25]. Therefore, a 22-year retrospective study for OCs was conducted at Tripoli University Hospital.

The purpose of this study was to determine the relative frequency and demographic features of OCs diagnosed histologically at Tripoli University Hospital in Tripoli, which represents the western region of Libya, according to the WHO classification (2022) of Head and Neck Tumors over 22 years, and to compare our findings with similar studies conducted previously from Libya and worldwide.

METHODS

Study Design and Sample

The database of the Department of Pathology at Tripoli University Hospital, Tripoli, Libya, was reviewed retrospectively for all registered orofacial biopsy specimens during the last 22 years (from January 2002 to December 2023). The inclusion criteria were histopathological reports with a diagnosis of OCs. The exclusion criteria were histopathological reports with inconclusive diagnoses.

The hematoxylin and eosin (H&E) stained slides of OCs were retrieved from the archive of the Department of Pathology. Then, they were re-evaluated carefully by the authors (two oral pathologists) to classify them according to the latest criteria of the 2022 WHO classification [9]. If significant inflammation was masking the histopathological features, clinical and radiographic features were considered. Generally, OCs were divided into inflammatory and developmental cysts.

Data collection

Demographic data about gender, age at diagnosis, and location of all histologically confirmed cases of OCs were obtained from the electronic biopsy records. The age was categorized into four groups (20-year intervals). The anatomical locations of OCs were divided into anterior, posterior, and unspecified regions for each mandible and maxilla. The anterior region was considered to extend from the right canine to the left canine region; the posterior region was considered to extend from premolars posteriorly, regardless of the side; the unspecified region was considered if the anatomical location was not determinate.

Statistical Analysis

The obtained data were analyzed using IBM SPSS Statistics (Statistical Product and Service Solutions) version 26.0® (IBM Corporation, Armonk, NY, USA). Descriptive statistics were performed: for categorical variables, results were expressed as frequency and percentages, while for continuous variables, values were expressed as mean ± standard deviation (SD). The Chi-square test (χ^2) and Fisher's exact test (in case of a non-valid Chi-square test) were conducted to assess the associations between categorical variables (gender, anatomical location, and age group) and types of OCs. We used the *t*-test to determine if there were differences between types of OCs (inflammatory or developmental) and continuous variables (age). The statistical significance level used was a P value < 0.05.

Ethical consideration

The study was conducted per the World Medical Association Declaration of Helsinki, and the patients' identities were kept anonymous in all cases. Ethical approval to perform this work was obtained from the Scientific Research and Ethics Committee at the University of Tripoli, Tripoli, Libya [reference number: SREC-010⁄61].

RESULTS

Among 2334 registered orofacial biopsy specimens from the Department of Pathology at Tripoli University Hospital, during 22 years, 227 (9.7%) specimens satisfied the criteria for histological diagnoses of OCs (Figure 1). Inflammatory OCs were more frequent than developmental OCs, accounting for 129 (56.8%) and 98 (43.2%) cases, respectively.

Apical radicular was the most common type of all studied cysts (54.2%; n = 123), followed by dentigerous cysts (31.3%; n = 71), and odontogenic keratocysts (5.3%; n = 12). These three most frequently diagnosed OCs comprised 90.7% of all cyst specimens. Figure 2 shows the distribution of OCs in the present sample.

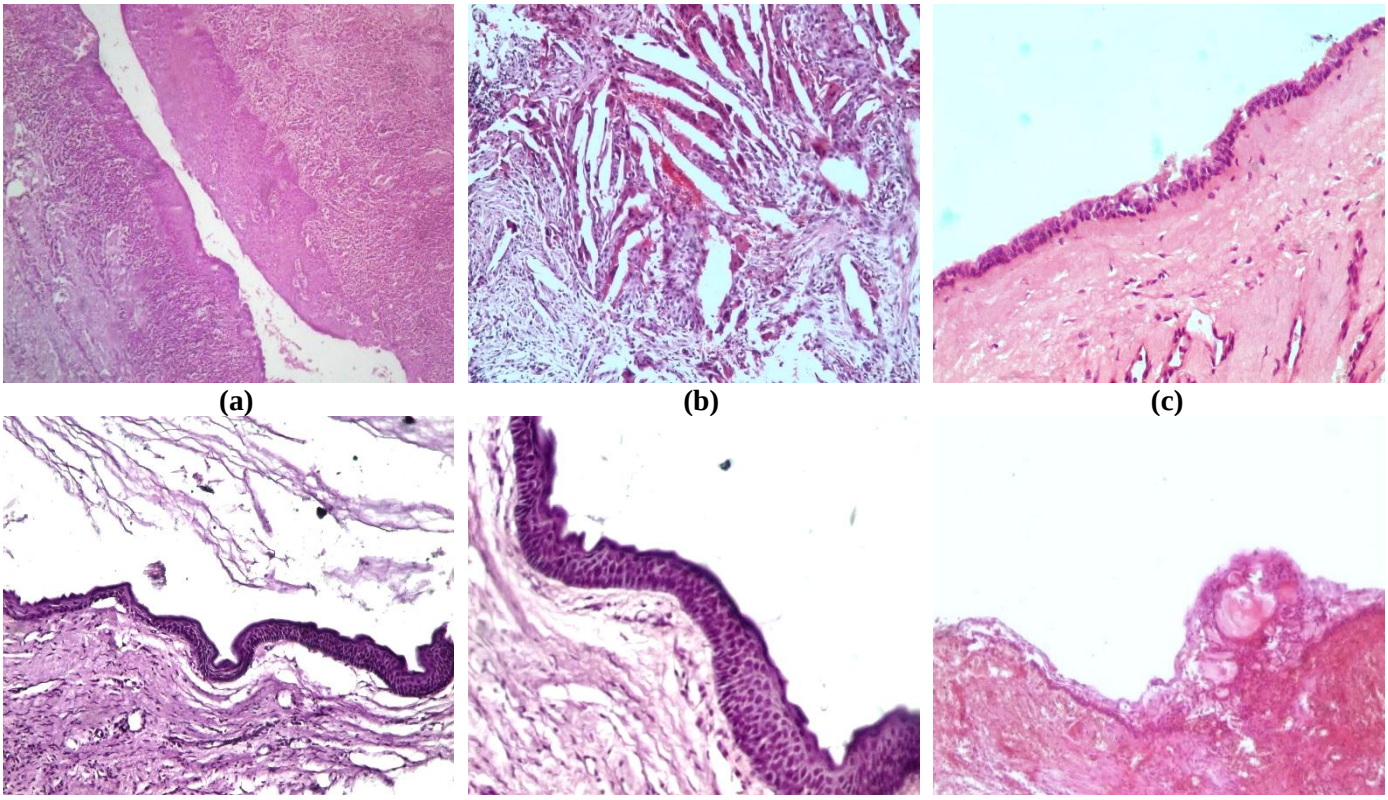


Figure 1. Photomicrographs demonstrating histopathological features of OCs. (a) Radicular cyst (H&E stain, X 100); (b) Cholesterol clefts (H&E stain, X 200); (c) Dentigerous cyst (H&E stain, X 200); (d) Odontogenic keratocyst (H&E stain, X 100); (e) Odontogenic keratocyst (H&E stain, X 200); (f) Calcifying odontogenic cyst (H&E stain, X 100).

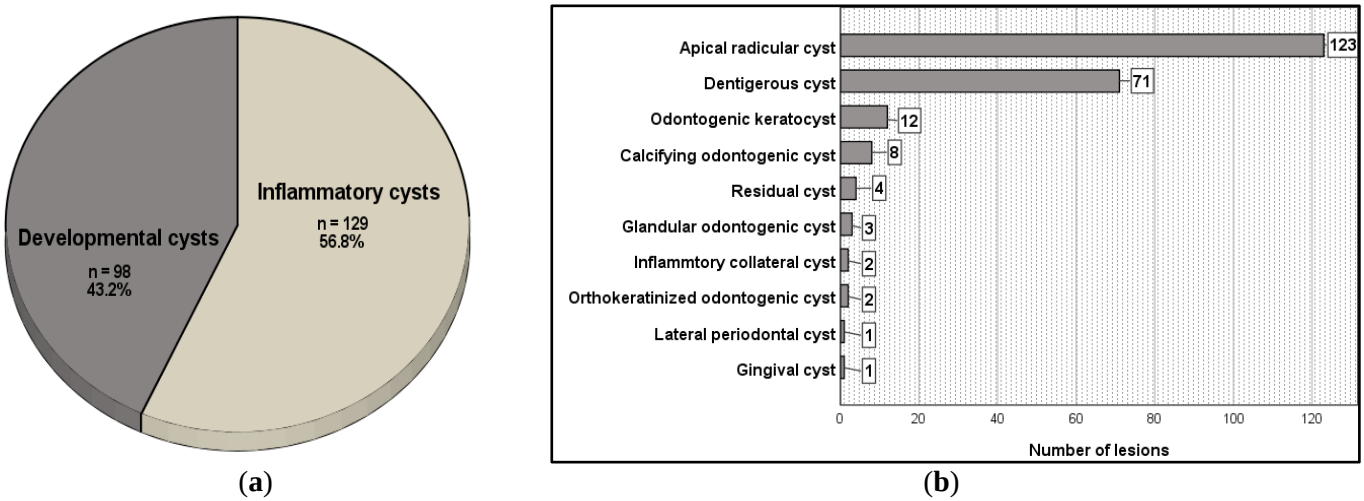
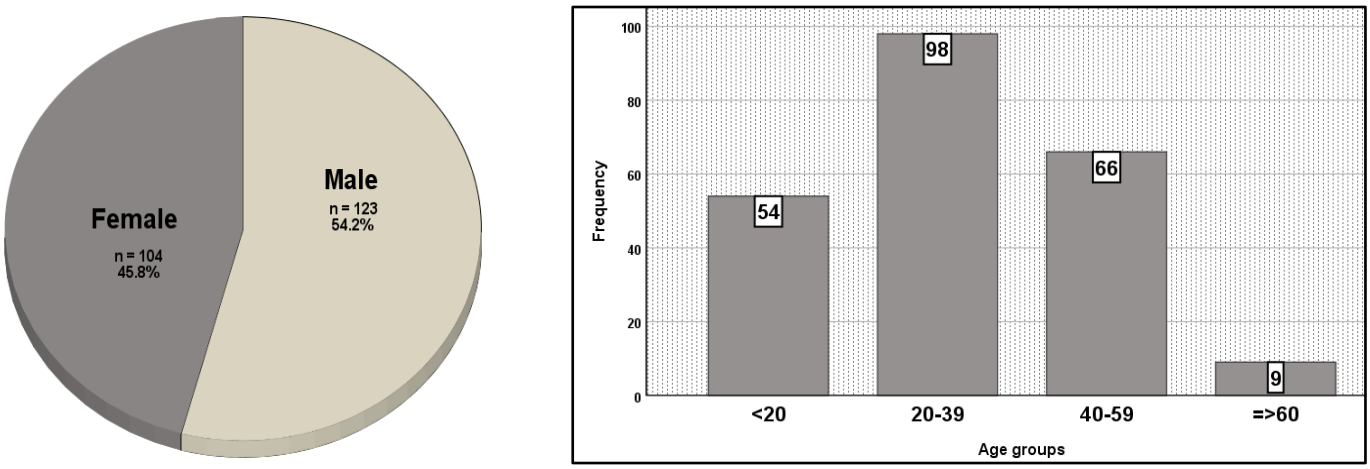


Figure 2. (a) Types of OCs in the present sample (n = 227); (b) Frequency of each OC.

Considering the gender distribution of all OCs, above half (54.2%; n = 123) of the cases were males, and 45.8% (104 cases) were females. The overall male-to-female ratio was 1.2:1. The anatomical locations were known in 59.9% (136 cases) of all cyst specimens, unfortunately in 40.1% (91 cases) of all studied cysts were unknown. Of the total cases, nearly one-third (31.7%; n = 72) of the lesions were located in the maxilla, while the mandible was affected in 64 (28.2%) cases. The posterior regions of the jaws were the most prevalent sites (34.4%) for all studied cysts. Regarding

age group distributions among all OCs, a wide age range was observed from 5 to 85 years, with an overall mean age of 33 ± 15.16 years at the diagnosis. The peak incidence was in the third and fourth decades of life (20-39 years old age group), accounting for 43.2% (98 cases) of all cases (Figure 3).



(**a**) (**b**)

Figure 3. (a) Gender distribution of OCs in the present sample (n = 227); (b) Age group distribution of OCs.

Table 1 summarizes the distribution of OCs in the present sample. Inflammatory OCs showed an almost equal gender predilection, whereas developmental OCs happened more in males (59.2%; n = 58). Based on the Chi-square test, there was no statistically significant association in gender distribution between types of OCs (χ^2 = 1.736; P = 0.226). According to available data for anatomical location, inflammatory OCs occurred more frequently in the maxilla, while developmental OCs were situated equally in the mandible and maxilla. No statistically significant association was found between types of OCs and their anatomical location (χ^2 = 3.194; P = 0.204). Patients with inflammatory OCs were older (36.29 ± 14.34 years) than the ones with developmental OCs (28.66 ± 15.20 years), and the *t*-test showed a statistically significant difference between types of OCs and their age (P < 0.001). Furthermore, inflammatory OCs become the most frequently reported with an increase in age; the Chi-square test showed a statistically significant association for age group distribution in types of OCs (χ^2 = 19.774; P < 0.001).

The distribution of OCs according to gender, anatomical locations, and age group are shown in Tables 2-4. Among all OCs, the apical radicular cyst was the most common inflammatory OC (54.2%; n = 123), and showed an almost equal gender distribution. Of 69 (56.1%) cases with the known site of presentation, above half (55.1%; n = 38) of them were situated in the maxilla, whereas the mandible was affected in 31 (44.9%) cases. Mandibular posterior regions were the most prevalent sites of the apical radicular cyst (16.3%; n = 20), followed by posterior regions of the maxilla (14.6%; n = 18). The mean age at the diagnosis was 36.15 ± 13.84 years, with peak occurrence in the age group of 20-39 years. Other inflammatory OCs presented low frequencies in this sample: residual cysts (1.8%; n = 4), and inflammatory collateral cysts (0.9%; n = 2). No statistically significant associations regarding gender, anatomical locations, and age group distributions between inflammatory OCs were observed (P > 0.05).

Regarding developmental OCs, the most frequent developmental cyst detected was the dentigerous cyst (71 cases), with 42 (59.2%) patients were males. The maxilla and mandible were almost equally affected among the 47 (66.2%) cases with known anatomical locations. Similar to the apical radicular cyst, the posterior regions of the mandible were the most prevalent sites of the dentigerous cyst (23.9%; n = 17), followed by the posterior regions of the maxilla (19.6%; n = 12). The mean age at the diagnosis was 27.52 ± 15.31 years, with peak incidence in the age group less than 20 years.

Table 1. Summary of distribution of OCs in the present sample (n = 227).

Variable	Total n (%)	Type of cyst, n (%)		P-value
		Inflammatory Cysts	Developmental cysts	
Gender				**0.226** [C]
Male	**123 (54.2)**	65 (50.4)	58 (59.2)	
Female	**104 (45.8)**	64 (49.4)	40 (40.8)	
Male: Female ratio	**1.2:1**	1:1	1.5:1	
Location				**0.204** [C]

Mandible	**64 (28.2)**	32 (24.8)	32 (32.7)	
Maxilla	**72 (31.7)**	39 (30.2)	33 (33.7)	
Unknown	**91 (40.1)**	58 (45.0)	33 (33.7)	
Age in years (Mean ± SD)	**33 ± 15.16**	36.29 ± 14.34	28.66 ± 15.20	**< 0.001*** [T]
Age range	**5 to 84 years**	8 to 84 years	5 to 70 years	
Age group				**< 0.001*** [C]
< 20 years	**54 (23.8)**	17 (13.2)	37 (37.8)	
20-39 years	**98 (43.2)**	61 (47.3)	37 (37.8)	
40-59 years	**66 (29.1)**	46 (35.7)	20 (20.4)	
≥ 60 years	**9 (4.0)**	5 (3.9)	4 (4.1)	
Total	**227 (100)**	**129 (56.8)**	**98 (43.2)**	

*Legend: [C] Chi-Square test; [T] t-test; * Statistically significant (P < 0.05).*

Table 2. Gender distributions of different types of OCs in the present sample (n = 227).

Type of cyst	Gender, n (%)		Total n (%)	P-value
	Male	Female		
Inflammatory Cysts				
Apical radicular cyst	62 (50.4)	61 (49.6)	**123 (54.2)**	**0.367** [F]
Residual cyst	1 (25.0)	3 (75.0)	**4 (1.8)**	
Inflammatory collateral cyst	2 (100)	0 (0)	**2 (0.9)**	
Developmental Cysts				
Dentigerous cyst	42 (59.2)	29 (40.8)	**71 (31.3)**	**0.860** [F]
Odontogenic keratocyst	8 (66.7)	4 (33.3)	**12 (5.3)**	
Orthokeratinized odontogenic cyst	1 (50.0)	1 (50.0)	**2 (0.9)**	
Calcifying odontogenic cyst	5 (62.5)	3 (37.5)	**8 (3.5)**	
Glandular odontogenic cyst	2 (66.7)	1 (33.3)	**3 (1.3)**	
Lateral periodontal cyst	0 (0)	1 (100)	**1 (0.4)**	
Gingival cyst	0 (0)	1 (100)	**1 (0.4)**	
Total	**123 (54.2)**	**104 (45.8)**	**227 (100)**	

Legend: [F] Fisher's exact test.

A total of 12 odontogenic keratocysts were identified, accounting for 5.3% of all studied cysts, with two-thirds (66.7%; n = 8) of them found in males. The exact site of occurrence was known in 8 (66.2%) lesions, and the mandible was the most commonly affected site (75%; n = 6). The most prevalent sites of odontogenic keratocyst were the posterior regions of the jaws (41.7%; n = 5). The mean age at the presentation was 33.67 ± 15.10 years, and most patients were between 20-59 years of age. Two cases with multiple odontogenic keratocysts in both jaws were reported.

Only eight cases of calcifying odontogenic cysts were reported, accounting for 3.5% of all OCs, and 5 (62.5%) patients were males. Among 7 (87.5%) cases where the site of presentation was indicated, the maxilla was the most frequently affected site (85.7%; n = 6), mainly the anterior region (37.5%; n = 3). The mean age at the presentation was 22.88 ± 8.54 years, and predominately seen in patients of the age group less than 20 years.

In our series, two cases of orthokeratinized odontogenic cysts, three cases of glandular odontogenic cysts, one case of lateral periodontal cyst, and one case of gingival cyst were found, accounting for 0.9%, 1.3%, 0.4%, and 0.4% all OCs, respectively. However, these developmental OCs were low in frequency (3% of all OCs) to make any demographic inference. In addition, an eruption cyst was not reported in this series. No statistically significant associations between developmental OCs and their gender, anatomical locations, and age group distributions were observed (P > 0.05).

A comparison of the relative frequency and distribution of OCs in the present study and relevant worldwide studies according to the WHO classification published in 2017 or 2022 is shown in table 5.

Table 3. Anatomical distributions of different types of OCs in the present sample (n = 227).

Type of cyst	Mandible, n (%)			Maxilla, n (%)			NR	Total n (%)
	Ant.	Post.	Unsp.	Ant.	Post.	Unsp.		
Inflammatory Cysts								
Apical radicular cyst	3 (2.4)	20 (16.3)	8 (6.5)	13 (10.6)	18 (14.6)	7 (5.7)	54 (43.9)	**123 (54.2)**
Residual cyst	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	**4 (1.8)**
Inflammatory collateral cyst	0 (0)	1 (50.0)	0 (0)	0 (0)	1 (50.0)	0 (0)	0 (0)	**2 (0.9)**

P-value	**0.111** [F]							
Developmental Cysts								
Dentigerous cyst	3 (4.2)	17 (23.9)	4 (5.6)	7 (9.9)	12 (19.6)	4 (5.6)	24 (33.8)	**71 (31.3)**
Odontogenic keratocyst	1 (8.3)	3 (25.0)	2 (16.7)	0 (0)	2 (16.7)	0 (0)	4 (33.3)	**12 (5.3)**
Orthokeratinized odontogenic cyst	1 (50.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50.0)	**2 (0.9)**
Calcifying odontogenic cyst	1 (12.5)	0 (0)	0 (0)	3 (37.5)	2 (25.0)	1 (12.5)	1 (12.5)	**8 (3.5)**
Glandular odontogenic cyst	0 (0)	0 (0)	0 (0)	0 (0)	2 (66.7)	0 (0)	1 (33.3)	**3 (1.3)**
Lateral periodontal cyst	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	**1 (0.4)**
Gingival cyst	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	**1 (0.4)**
P-value	**0.176** [F]							
Total	**9 (4.0)**	**41 (18.1)**	**14 (6.2)**	**23 (10.1)**	**37 (16.3)**	**12 (5.3)**	**91 (40.1)**	**227 (100)**

Legend: Ant., anterior; Post., posterior; Unsp., unspecified; NR, not reported; [F] *Fisher's exact test.*

Table 4. Age group distributions of different types of OCs in the present sample (n = 227).

Type of cyst	**Age group, n (%)**				**Total n (%)**	**Age in years (Mean ± SD)**	**P-value**
	< 20 years	**20-39 years**	**40-59 years**	**≥ 60 years**			
Inflammatory Cysts							
Apical radicular cyst	16 (13.0)	59 (48.0)	44 (35.8)	4 (3.3)	**123 (54.2)**	36.15 ± 13.84	**0.303** [F]
Residual cyst	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)	**4 (1.8)**	42.50 ± 30.14	
Inflammatory collateral cyst	0 (0)	1 (50.0)	1 (50.0)	0 (0)	**2 (0.9)**	34.50 ± 9.19	
Developmental Cysts							
Dentigerous cysts	29 (40.8)	26 (36.6)	13 (18.3)	3 (4.2)	**71 (31.3)**	27.52 ± 15.31	**0.240** [F]
Odontogenic keratocyst	2 (16.7)	5 (41.7)	5 (41.7)	0 (0)	**12 (5.3)**	33.67 ± 15.10	
Orthokeratinized odontogenic cyst	0 (0)	1 (50.0)	1 (50.0)	0 (0)	**2 (0.9)**	38.50 ± 20.51	
Calcifying odontogenic cyst	5 (62.5)	2 (25.0)	1 (12.5)	0 (0)	**8 (3.5)**	22.88 ± 8.54	
Glandular odontogenic cyst	0 (0)	2 (66.7)	0 (0)	1 (33.3)	**3 (1.3)**	47.00 ± 17.58	
Lateral periodontal cyst	0 (0)	1 (100)	0 (0)	0 (0)	**1 (0.4)**	30.00 (NA)	
Gingival cyst	1 (100)	0 (0)	0 (0)	0 (0)	**1 (0.4)**	20.00 (NA)	
Total	**54 (23.8)**	**98 (43.2)**	**66 (29.1)**	**9 (4.0)**	**227 (100)**	**33 ± 15.16**	

Legend: NA, not applicable; [F] *Fisher's exact test.*

Table 5. Comparison of frequency and distribution of OCs in the present study and relevant worldwide studies.

Authors (year)	**Present Study (2024)**	**Buaoud *et al.* (2023)** [11]	**Almazyad *et al.* (2023)** [12]	**Al-Qazzaz *et al.* (2023)** [13]	**Khandelwal *et al.* (2024)** [14]	**Izgi *et al.* (2021)** [15]
Country of study	Tripoli, Libya	Benghazi, Libya	Riyadh, Saudi Arabia	Baghdad, Iraq	Rajasthan, India	Ankara, Turkey
Period (years)	22 years	13 years	12 years	11 years	5 years	10 years
Sample size	227	276	372	368	218	467
Gander, n (%)						
Male	123 (54.2)	145 (52.5)	225 (60.48)	222 (60.33)	110 (55)	271 (58.03)
Female	104 (45.8)	131 (47.5)	147 (39.52)	146 (39.67)	90 (45)	196 (41.97)
Location, *n (%)*						
Mandible	64 (28.2)	119 (43.2)	196 (53.0)	186 (50.54)	86 (39.45)	302 (64.67)
Maxilla	72 (31.7)	157 (56.8)	176 (47.0)	182 (49.46)	132 (60.55)	165 (35.33)
Unknown	91 (40.1)	NR	NR	NR	NR	NR
Mean age	33 years	32 years	32 years	32.4 years	35.74 years	NR
Type of OCs, n (%)						
Apical radicular cyst	123 (54.2)	167 (60.5)	186 (50.0)	212 (57.61) *	108 (49.55)	230 (49.65) *
Residual cyst	4 (1.8)	17 (6.14)	4 (1.1)	NR	21 (9.65)	NR
Inflammatory collateral cyst	2 (0.9)	2 (0.75)	1 (0.3)	1 (0.27%)	5 (2.29)	36 (7.71)

Dentigerous cyst	71 (31.3)	41 (14.8)	109 (29.3)	59 (16.03)	29 (13.30)	106 (22.7)
Eruption cyst	NR	NR	2 (0.5)	NR	NR	1 (0.27)
Odontogenic keratocyst	12 (5.3)	40 (14.5)	53 (14.2)	66 (17.93)	27 (12.35)	64 (13.7)
Orthokeratinized odontogenic cyst	2 (0.9)	2 (0.75)	2 (0.5)	3 (0.82)	NR	NR
Calcifying odontogenic cyst	8 (3.5)	5 (1.81)	NR	19 (5.16)	6 (2.75)	2 (0.43)
Glandular odontogenic cyst	3 (1.3)	2 (0.75)	8 (2.1)	6 (1.63)	3 (1.38)	5 (1.07)
Lateral periodontal cyst	1 (0.4)	NR	3 (0.9)	1 (0.27)	7 (3.21)	4 (0.86)
Gingival cyst	1 (0.4)	NR	NR	1 (0.27)	5 (2.29)	NR
Other cysts	NR	NR	4 (1.1)	NR	7 (3.21)	20 (4.28)

*Legend: NR, not reported; * reported as radicular cyst.*

DISCUSSION

The fifth edition of the WHO classification of odontogenic and maxillofacial bone tumors published in 2022, is conceptually similar to the previous fourth edition of the WHO classification published in 2017. In the 2017 WHO classification [8], the cysts of the jaws were divided into three groups: odontogenic cysts of inflammatory origin, odontogenic/non-odontogenic developmental cysts, and bone cysts, whereas in the 2022 WHO classification [9], the heading "cysts of the jaws" has been used without any subdivision. The latest WHO classification included two inflammatory cysts: radicular cysts and inflammatory collateral cysts, and seven developmental cysts: dentigerous cysts, odontogenic keratocysts, orthokeratinized odontogenic cysts, glandular odontogenic cysts, calcifying odontogenic cysts, lateral periodontal cysts/botryoid odontogenic cysts, and gingival cysts [9]. The present study aimed to update the frequency and demographical characteristics of OCs diagnosed histologically at Tripoli University Hospital over 22 years according to the 2022 WHO classification. Our results were compared with relevant studies using the 2017 WHO or 2022 WHO classifications to achieve better accuracy.

A total of 227 specimens met the criteria to be histologically diagnosed as OCs, accounting for 9.7% of all registered orofacial biopsy specimens. This finding is comparable with the results of Buaoud *et al*. [11], who showed a relatively close frequency (12.6%) in the eastern regions of Libya. This result may indicate that OCs are not a rarity in the Libyan population. When the results of the current study were compared with the results of the latest reports from different countries, it was found that the studies from Iraq [13], South Brazil [16], North India [17], and South India [18] reported similar frequencies ranging from 10.8% to 11.26%. However, a study from Turkey [15] reported a prevalence of 63.19%, which is significantly very high compared with our results. On the contrary, studies involving Nigerian [19] and Brazilian [26] populations have shown lower frequencies of OCs, accounting for 3.9% and 4.87% of all OCs studied, respectively. The variation in the prevalence of OCs might be explained by differences in the study design used or the ethnic characteristics of the population [11].

In our sample, inflammatory OCs were more frequent than developmental OCs, accounting for 56.8% and 43.2% of all OCs, respectively, which is in agreement with other studies conducted by Almazyad *et al*. [12], Al-Qazzaz *et al*. [13], Savithri *et al*. [18], Mammadov [20], Kammer *et al*. [16], and Buaoud *et al*. [11], who reported that inflammatory OCs accounted for 51.34%, 57.88%, 61.2%, 63.01%, 67%, and 67.39% of all OCs studied, respectively. In contrast, published studies from Brazilian [26] and Nigerian [27] samples found a predominance of developmental cysts. The probable reasons might be due to the socioeconomic characteristics of the population studied or the fact that inflammatory OCs are not usually submitted to the pathology laboratory [11,26]. The high frequency of inflammatory OCs suggests that appropriate oral health and regular dental checkups might help to reduce the prevalence of OCs [16].

In the current study, the most frequently diagnosed OCs were apical radicular cysts, dentigerous cysts, and odontogenic keratocysts. These lesions comprised 90.7% of all reported OCs in our sample, which is in line with other reports worldwide [11,14,15,17,23].

Regarding gender distribution in our series, we reported a slight male predilection (54.2%) with an overall male-to-female ratio of 1.2:1, which is consistent with a previous study from Libya (52.5%) and other studies performed in different countries involving populations from Nigeria (54.15%), India (55%), South Brazil (56,73%), North India (57.2%), Turkey (58%), and Portugal (58.3%) [11,14–17,23,27]. These higher men's tendency to develop OCs might be attributed to their poorer oral hygiene and greater trauma susceptibility compared to women as risk factors for cyst formation [28]. On the other hand, female predominance was significant in Indonesian [29] and Brazilian samples [26]. This finding might be explained by the fact that women consult health professionals more often than men [28]. There was no statistically significant difference in the gender distribution of OCs in our sample, a finding similarly reported by Nwoga from Nigeria [27].

The overall mean age occurrence of OCs in this sample was 33 ± 15.16 years and the peak incidence was in the third and fourth decades of life, which is in line with studies conducted by Almazyad *et al*. [12], Buaoud *et al*. [11], and Al-Qazzaz *et al*. [13], who reported that the overall mean age of all OCs was 32 years, 32 years, and 32.4 years, respectively. Our series found that patients with inflammatory OCs were usually older than those with developmental OCs. Inflammatory OCs become the most frequently reported with an increase in age. Furthermore, there was a statistically significant association for age group distribution in types of OCs in our sample, which is in agreement with the results of Savithri *et al*. from South India [18], Kammer *et al*. from South Brazil [16], and Mammadov from Germany [20]. These findings might be explained by the fact that inflammatory OCs like radicular cysts arise as a sequela of pulp inflammation over a long period, whereas developmental OCs like dentigerous cysts are more frequently observed in the younger age due to odontogenic rests being more active in young patients [18,20].

Unfortunately, the anatomical location was unknown in 40.1% of all studied cysts. This finding might be explained by the fact that some practitioners are careless when filling out clinical data in the biopsy request forms sent to our service. According to available data, nearly one-third (31.7%) of the lesions were located in the maxillae, while 28.2% of the cases were situated in the mandible. The posterior regions of the jaws were the most prevalent sites (34.4%) for all studied cysts. The mandible was reported as the most prevalent site for OCs by several studies of the literature [13,16,18,19,21,26,27,30], whereas other studies reported the occurrence of OCs was frequently observed in the maxilla [11,14,23,29]. This variation might be attributed to the fact that inflammatory OCs like radicular cysts are frequently located in the anterior maxilla and may arise secondary to trauma resulting in pulp necrosis and subsequent cyst formation, whereas developmental OCs like dentigerous cysts and odontogenic keratocysts commonly occur in the posterior mandible and are associated with impacted third molars [6,10,16,17,31].

According to the 2022 WHO classification [9], radicular and residual cysts are considered one entity because a residual cyst represents a radicular cyst left behind after extraction of the related tooth in the jaw bone. To compare our results with the results of other studies, the residual and radicular cysts were retained as two separate entities. It is not surprising that apical radicular cyst was the most common type of all OCs, accounting for 54.2% of all studied cysts. Similar results were found in most of the previous studies involving populations from Pakistan (37.1%), South Brazil (46.06%), India (49.55%), South India (50%), Saudi Arabia (50.0%), North India (54.54%), Greece (57.3%), Iraq (57.61%), Germany (57.9%), and Libya (60.5%) [11–14,16–18,20,21,32]. We found that apical radicular cysts occurred over a wide age range, with a peak of incidence in the third and fourth decade, this is comparable with most of the previous studies [11,13,14,17,23,30,32]. Most previously published reports have shown a male preference for radicular cysts [11–15,21,23,26,30,32], whereas the current study found an approximately equal sex distribution. This finding might be attributed to the small sample size of this cohort. On the other hand, female predominance for radicular cysts was significant in the North Indian sample [17]. The probable explanation for their finding might be attributed to the fact that women in the North Indian population delay seeking medical and dental treatment and their socioeconomic characteristics [17]. The posterior regions of the jaws were the most commonly affected exact site, which is consistent with several published studies [12,15,16,23], while studies by Buaoud *et al*. [11], Khandelwal *et al*. [14], *Olusanya et al*. [19], Izaz *et al*. [21], and Tamiolakis *et al*. [32] reported that radicular cysts occurred more frequently in the anterior region of the maxilla.

The prevalence of residual cysts was low in the literature, ranging from 0.25% to 14.1% [13,14,17,20,32]. No difference was observed in our sample (1.8%). Inflammatory collateral cysts are another rare inflammatory OCs with two distinct subtypes: paradental cysts arising on the distobuccal aspect of lower third molars, and mandibular buccal bifurcation cysts arising on the buccal aspect of partially erupted lower first and second molars [8]. Only two cases of inflammatory collateral cysts were found in our series, which is consistent with the previous studies [11–13]. On the contrary, Izgi *et al*. [15], Tamiolakis *et al*. [32], and Kammer *et al*. [16] found 36, 53, and 55 cases of inflammatory collateral cysts in their samples, respectively. The high number of cases in their series might be explained by their large sample size, mainly from the young population. Inflammatory collateral cysts might be histologically diagnosed as a dentigerous cyst because of incomplete clinical and/or radiological information on the biopsy request form [33]. Furthermore, these cysts are probably under-reported, because the majority of cases are treated conservatively or undetected as they resolve spontaneously with tooth eruption [12].

In the present sample, the dentigerous cyst was the second most common OC, accounting for 31.3% of all studied cysts. This finding is similar to those reported in Greece [32], Libya [11], Portugal [23], North India [17], Turkey [15], Brazil [26], Saudi Arabia [12], Germany [20], and Pakistan [21], where the dentigerous cyst was also the second most common OC, with frequencies ranging from 14.7% to 33.7%, with a male predilection. On the contrary, a study conducted in South Nigeria by Iyogun *et al*. [22] reported that dentigerous cysts were more common than radicular cysts in their sample, accounting for 65.4% of all studied cysts. The probable explanation for their finding is that radicular cysts are

not usually submitted for histopathological analysis. In our series, most dentigerous cysts occurred in the posterior regions of the mandible. This is not surprising, considering that the lower third molars are the most commonly impacted teeth that lead to the development of dentigerous cysts [6]. An eruption cyst is categorized as a soft tissue variant of dentigerous cysts overlying an erupting tooth [9], and its frequency in the literature ranges from 0.5% to 2.8% of all jaw cysts [12,20]. In agreement with other studies [11,13], we did not find any cases of eruption cysts in our cohort. The low prevalence of eruption cysts might be explained by the fact their asymptomatic nature, and usually subside spontaneously; for these reasons, they are rarely biopsied and sent for histopathological diagnosis [12,34].

The third most common OC in the current series was odontogenic keratocyst, which is similar to the findings in the previous studies from Portugal [23], India [14], Turkey [15], Saudi Arabia [12], Libya [11], Brazil [26], North India [17], and Pakistan [21], with frequencies ranging from 11.5% to 27%. The lower frequency of odontogenic keratocysts observed in our sample (5.3% of all studied cysts) might be attributed to the small sample size or the racial characteristics of the studied population. However, studies conducted by Al-Qazzaz *et al*. [13], Kammer *et al*. [16], and Savithri *et al*. [18] reported that odontogenic keratocyst was the second most common OC after radicular cysts, whereas studies of Nwoga from Nigeria [27] and Li *et al*. from China [30] found the odontogenic keratocyst the most common OC. Moreover, Tamiolakis *et al*. [32] showed that residual cysts were more frequently observed than odontogenic keratocysts. Demographic data in the present sample and previously published reports are consistent; odontogenic keratocyst occurred more commonly in the second to fifth decades with male predilection, and mandibular preference [11–15,17,21,30,32]. Multiple cases of odontogenic keratocysts have been reported in the literature that could be associated with Nevoid basal cell carcinoma (Gorlin-Goltz) syndrome [12,16,23,32]. In our study, we observed two patients with multiple odontogenic keratocysts in both jaws. The data for this study was obtained from the biopsy request forms sent to the pathology service, which did not include records of follow-up and information on other symptoms of this syndrome. Therefore, we could not draw any conclusions about the prevalence of this syndrome in our sample.

Orthokeratinized odontogenic cyst was considered a separate entity from odontogenic keratocyst in the 2017 WHO classification [8]. The prevalence of orthokeratinized odontogenic cysts was low in the literature, ranging from 0.3% to 1.77% of all jaw cysts [12,13,16,23,26,32]. Only two cases of orthokeratinized odontogenic cysts were found in our series, which is consistent with previous studies [11–13,26].

According to the latest WHO classification, the calcifying odontogenic cyst is considered a developmental OC, and the presence of characteristic ghost cells that may undergo calcification is sufficient for its diagnosis, while the ameloblastoma-like epithelial lining is a desirable diagnostic feature. Additionally, odontoma-associated calcifying odontogenic cysts are no longer separated from the rest of calcifying odontogenic cysts [9]. Its reported frequency in the literature ranges from 0.43% to 5.16% of all jaw cysts [11,13,14,18,26]. We reported eight cases of calcifying odontogenic cysts, accounting for 3.5% of all studied cysts. One study from Brazil [26] showed a similar frequency to our series (3.51%), while a study from Iraq [13] showed a relatively close frequency (5.16%).

In the 2017 WHO classification [8], ten histopathological features were accepted for glandular odontogenic cysts, and observation of at least seven criteria was strongly suggestive of its diagnosis. However, according to the 2022 WHO, not all criteria are present in all lesions, with the sole essential criterion being the presence of hobnail cells [9]. In the current study, three cases of glandular odontogenic cysts were found, accounting for 1.3% of all OCs. Our finding is closely parallel to frequencies reported in studies by Izgi *et al*. [15] and Al-Qazzaz *et al*. [13], who reported that the glandular odontogenic cysts accounted for 1.09% and 1.63% of all studied cysts, respectively. In addition, we reported only one case of each lateral periodontal cyst and gingival cyst, findings similarly reported by Al-Qazzaz *et al*. from Iraq [13].

This study was conducted at Tripoli University Hospital, the largest teaching hospital in Libya with a capacity of over 1200 beds, and most cases were from the western region of Libya. Additionally, the current study analyzed OCs for 22 years, providing important baseline data on these lesions. However, this retrospective study has limitations as it relied on data from a single institution, which only included demographic information and histopathological diagnoses of OCs. There is also missing information, particularly related to location, follow-up, radiographic features, and recurrence in this hospital-based database.

CONCLUSION

This study presents the frequency and demographic profile of OCs in a sample of the Libyan population based on the latest WHO classification. The prevalence of OCs in this population is 9.7%, and the demographic profile of OCs is relatively similar to the previous reports in Libyan and other worldwide populations. Among studied OCs, inflammatory cysts were the most frequently observed. The commonly diagnosed OCs include apical radicular cysts, dentigerous cysts, and odontogenic keratocysts. Therefore, regular dental checkups are important for early detection and treatment

of these lesions. Moreover, a strict protocol for filling data in the biopsy request form is required to achieve complete patient information for accurate diagnosis, and for proper documentation to obtain precise archives for future retrospective studies at Tripoli University Hospital.

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

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تكرار والملف الديموغرافي للأكياس السنية المشخصة في مستشفى طرابلس الجامعي، ليبيا

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المستخلص

الأكياس السنية المنشأ هي مجموعة من الآفات التي تؤثر حصريا على مناطق الفم والوجه والفكين. تهدف الدراسة الحالية إلى تحديد التكرار النسبي والسمات الديموغرافية للأكياس السنية المشخصة نسيجيا في مستشفى طرابلس الجامعي ومقارنة نتائجنا بأحدث التقارير. دراسة رجعية لمدة 22 سنة للأكياس السنية التي تم تشخيصها نسيجيا في مستشفى طرابلس الجامعي، طرابلس، ليبيا، منذ سنة 2002 إلى سنة 2023 تم إجراؤها. تم جمع وتحليل البيانات الديموغرافية بما في ذلك الجنس والعمر عند التشخيص وموقع الآفة والتشخيص النسيجي المرضي بأثر رجعي. كان التشخيص وفقا لأحدث معايير تصنيف منظمة الصحة العالمية لعام 2022. شكلت الأكياس السنية المنشأ 9.7% من جميع عينات خزعة الفم والوجه المسجلة البالغ عددها 2334 عينة. تم تحليل 227 حالة من الأكياس السنية المشخصة نسيجيا. من بينهم، كان هناك عدد 129 (56.8%) من الأكياس الالتهابية وعدد 98 (43.2%) من الأكياس التنموية. كان الكيس الجذر القمي هو النوع الأكثر شيوعا من الأكياس (54.2%)، يليه الكيس السني (31.3%)، والكيسة القرنية السنية (5.3%). لوحظ ميل طفيف للذكور مع نسبة إجمالية من الذكور إلى الإناث تبلغ 1.2: 1. وتراوحت الفئة العمرية بين 5 و85 سنة بمتوسط عمر إجمالي يتراوح بين 33 ± 15.16 سنة. كانت ذروة الإصابة في العقدين الثالث والرابع من العمر. كانت المناطق الخلفية من الفكين هي المواقع الأكثر شيوعا (34.4%) لجميع الأكياس السنية المدروسة. يتشابه الملف الديموغرافي للأكياس السنية المنشأ في هذه المجموعة مع التقارير السابقة في السكان الليبيين وغيرهم من السكان في جميع أنحاء العالم.

الكلمات المفتاحية: الكيس السني، الانتشار، التردد، الديموغرافي، بأثر رجعي، ليبيا.