

# Odontogenic Cysts: Analysis of 680 Cases in Brazil

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**Abstract** The purpose of this study was to evaluate the prevalence of 680 odontogenic cysts diagnosed in Porto Alegre, RS, Brazil, and to compare results with findings in the literature. Data of odontogenic cysts diagnosed from 1985 to 2005 were collected from the files of the Oral Pathology Laboratory of Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil, and entered in a standardized form for later comparisons. The most prevalent odontogenic cysts were radicular (72.50%), dentigerous (22.20%) and residual (4.26%) cysts. The mandible of white patients was the anatomic site and ethnic group most frequently affected by this disease. Four of the six types of cysts were more frequent in the second and fourth decades of life, and no significant differences were found between sexes in the diagnosis of odontogenic cysts.

In conclusion, the prevalence of odontogenic cysts was similar to that reported in the literature, which shows that inflammatory cysts are the most frequent.

**Keywords** Odontogenic cysts · Radicular · Dentigerous · Keratocyst

## Introduction

Jaw bone cysts are characterized by a pathologic cavity partially or totally covered by epithelial tissue. The epithelium of odontogenic cysts originates in dental embryogenesis [1].

Odontogenic cysts account for 7–13% of the lesions diagnosed in the oral cavity [2–5]. Most of these cysts affect adult men [2–8]. Some studies found that the maxilla was the most frequent anatomic site [3, 7, 9], whereas other authors reported that the mandible was the most prevalent site [6, 8].

Odontogenic cysts are divided into two types according to their origin: developmental and inflammatory. Developmental cysts are of unknown origin, but do not seem to result from inflammation, whereas inflammatory cysts are associated with inflammation.

Studies about the prevalence of odontogenic cysts have been conducted in several countries and with different ethnic groups [2–10].

Odontogenic keratocysts were recently redefined and classified as keratocystic odontogenic tumors (KOT) [11], and this change from cyst to tumor had an impact in studies, such as the one reported here, because it affected the frequency rates of odontogenic cysts.

The purposes of this study were to evaluate the prevalence of odontogenic cysts diagnosed in Porto Alegre, RS,

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Brazil, according to ethnic group, sex, age, anatomic site and diagnosis; to correlate results of the group of odontogenic cysts with and without the inclusion of KOT; and to compare results with findings in the literature.

## Materials and Methods

This study was approved by the Committee on Ethics and Science of the School of Dentistry of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, RS, Brazil. We reviewed the histopathological diagnoses obtained from biopsies performed by undergraduate and graduate dentistry students in the oral surgery program, between 1985 and 2005, retrieved from the files of the Oral Pathology Laboratory of PUCRS, in the city of Porto Alegre, Brazil. Data about diagnosis, ethnicity, sex, age and anatomic site of all cases of odontogenic cysts were compiled from clinical data sent along with the biopsy records.

Odontogenic cysts were classified according to the World Health Organization (WHO) 1992 histological typing [12]. The following types of cysts were identified in the review of histopathological diagnoses: radicular, residual, paradental, dentigerous, primordial or odontogenic keratocyst (keratocystic odontogenic tumor), lateral periodontal or botryoid odontogenic, and eruption cysts. Glandular odontogenic cysts and calcifying odontogenic cysts were not included in the study due to lack of cases diagnosed in our laboratory. The following anatomic sites were defined: maxilla, anterior maxilla, anteroposterior maxilla, posterior maxilla, mandible, anterior mandible, anteroposterior mandible and posterior mandible. Anterior was defined as the region from canine to canine; anteroposterior, the premolar region; and posterior, the molar region. Sites were classified only as maxilla or mandible when files did not contain information about the specific site. Patients were classified according to ethnicity as: white, black or mixed race. Data about sex and age of patients were also collected; age was reported as decade of life, from the first to the eighth decade or older.

Some records were incomplete, but were nonetheless included in the study. The incomplete data were not used to calculate percentages. After collection of data, results were analyzed to calculate the prevalence of lesions and their association with the variables under study.

In 2005, the WHO [11] issued a new classification for odontogenic cysts and tumors, renaming odontogenic keratocyst (OKC) as keratocystic odontogenic tumors (KOT). In order to allow a comparison with studies carried out before 2005 [2–10], 28 cases of OKC, now KOT, found in our laboratory data were later included in our study and the results were elaborated in the discussion.

## Results

In the 20 years under study, 6,503 specimens were examined in the Oral Pathology Laboratory of the Pontifícia Universidade Católica do Rio Grande do Sul, 680 (10.45%) of which were odontogenic cysts. The most frequent cysts were radicular and dentigerous (Table 1).

The analysis of radicular cysts (493 cases) revealed that 314 cases (66%) occurred in the maxilla. The most frequent sites were the anterior maxilla, which accounted for 182 cases (38.24%), and the posterior mandible, with 111 cases (23.32%). No statistically significant difference between sexes was found—254 cases (52.37%) occurred in women, and 231 (47.62%), in men. The analysis of ethnicity revealed that 335 (80.91%) of the radicular cysts occurred in white patients, 57 (13.76%) in black patients, and 22 (5.31%) in mixed-race patients; the records of 79 radicular cysts contained no information about ethnicity. Most cysts occurred in the fourth decade of life (156 of the cases; 33.12%), followed by the third (114; 24.20%) and the fifth decades (86; 18.25%).

Dentigerous cysts accounted for 151 cases (22.20%) of all odontogenic cysts diagnosed in the Oral Pathology Service of PUCRS. The mandible was affected in 98 cases (69%); the posterior region was the most frequent anatomic site, with 87 (61.27%) cases, followed by the anterior maxilla, with 24 cases (16.9%). No significant differences were found between sexes: 78 cases (52%) of the dentigerous cysts occurred in women, and 72 cases (48%) in men. Most cysts occurred in white patients (115 of the cases; 87.12%), and in the second decade of life (62 of the cases; 42.46%), followed by the third decade (47 cases; 32.19%).

Residual cysts were the third most prevalent type of odontogenic cyst (29 cases; 4.26%). No significant difference in frequency was found between cysts in the maxilla (13 cases; 48.20%) and in the mandible (14 cases; 52.80%). Most

**Table 1** Prevalence of odontogenic cysts classified according to Kramer et al. [12] (1992) and Philipsen [11] (2005)

Odontogenic cyst	Kramer et al. [12] (1992) (%)	Philipsen [11] (2005) (%)
Radicular (493)	69.63	72.50
Dentigerous (151)	21.32	22.20
Residual (29)	4.09	4.26
OKC (28)	3.95	–
Paradental (4)	0.56	0.58
Lateral periodontal (2)	0.28	0.29
Eruption (1)	0.14	0.14
Total (680)	100	100

OKC = odontogenic keratocyst

Source: Department of Oral Pathology, School of Dentistry, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

residual cysts occurred in men (17 cases; 58.62%), and in white patients (19 cases; 70.37%), followed by mixed-race (5 cases; 18.51%) and black patients (3 cases; 11.11%). The most frequent age at the time of diagnosis of residual cysts was the eighth decade of life (7 cases; 25%); followed by the fourth and sixth decades of life (6 cases each; 21.42%).

Four cases (0.58%) of paradental cysts were found. No differences between sexes were found. All paradental cysts occurred in white patients and were located in the mandible: 1 case in the region of a second molar, and 3 in the region of third molars. Three cases (75%) occurred in the second decade of life.

Lateral periodontal cysts were rarely diagnosed in the 20 years under study: only 2 cases were found, both in the mandible of white patients. No difference between sexes was found. One patient was affected in the fourth decade of life, and the other, in the sixth.

Only one case of eruption cyst was found in the records analyzed. The patient was an 8-year-old boy, and the cyst was found in the maxilla (tooth #21); biopsy records did not contain information about the patient's ethnicity.

Table 2 shows epidemiological data of patients diagnosed with odontogenic cysts in the Oral Pathology Laboratory of PUCRS.

## Discussion

According to some studies [4, 5], odontogenic cysts are diagnosed in 7–12% of all oral and maxillofacial biopsies,

which is in agreement with our findings (10.88% with and 10.45% without OKC). In our study, cysts occurred in adult men more frequently than in women, which is in agreement with findings reported in other studies [2–8]. The maxilla was the anatomic site most often affected by odontogenic cysts in our study, which differs from findings by Meningaud et al. [6] and Koseoglu et al. [8], but is in agreement with other studies [3, 7, 9]. Although cysts show predilection for the maxilla, in four of the six cases diagnosed in our study, the mandible was the most prevalent site (Table 3).

Radicular cysts are inflammatory lesions caused by infection of the tooth pulp chamber. Toxins exit the apical foramen and infect the connective tissue of the periodontal ligament. The inflammatory response induces the proliferation of epithelial rests of Malassez and the formation of a cystic lesion [13]. Radicular cysts are the most prevalent odontogenic cysts according to all studies reviewed, with variations only in percentages. In our study, radicular cysts accounted for 72.5% (69.63% with the inclusion of OKC) of all cases, a higher percentage than those found by Jones et al. [2] (52.3%), Ochsenius et al. [3] (50.7%), Mosqueda-Taylor et al. [4] (39.9%), Ledesma-Montes et al. [5] (38.8%), Meningaud et al. [6] (53.5%), Bataineh et al. [7] (41.7%) and Koseoglu et al. [8] (59%), but lower than the percentages reported by Varinauskas et al. [9] (86.2%) and Franklin and Jones [10] (80%). The high rate of radicular cysts found by Franklin and Jones [10] may be explained by the fact that their study was conducted with biopsies performed by general dental practitioners, instead of oral

**Table 2** Epidemiological profile of patients with odontogenic cysts

Cyst	Site	Ethnicity	Age	Sex
Radicular	Maxilla (66%)	White (80.9%)	4th decade (33.1%)	Female (52.3%)
Dentigerous	Mandible (69%)	White (80.9%)	2nd decade (44.4%)	Female (52%)
Residual	Mandible (52.8%)	White (70.3%)	8th decade (25%)	Male (58.6%)
Paradental	Mandible (100%)	White (100%)	2nd decade (75%)	Male/Female (50%)
Lateral periodontal	Mandible (100%)	White (100%)	4th and 6th decades (50%)	Male/Female (50%)
Eruption	Maxilla (100%)	Inconclusive	1st decade (100%)	Male (100%)

Source: Department of Oral Pathology, School of Dentistry, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

**Table 3** Prevalence of odontogenic cysts according to anatomic site

Cyst	1st site	2nd site	3rd site
Radicular	Anterior maxilla	Posterior mandible	Posterior maxilla
Dentigerous	Posterior mandible	Anterior maxilla	Posterior maxilla
Residual	Mandible	Anterior maxilla	Posterior mandible
Paradental	Posterior mandible	–	–
Lateral periodontal	Posterior mandible	–	–
Eruption	Anterior maxilla	–	–

Source: Department of Oral Pathology, School of Dentistry, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

and maxillofacial surgeons, which reduced the number of more complex lesions. In the study conducted by Varinauskas et al. [9], 10.77% of the radicular cysts were also classified as residual cysts. The prevalence of female sex was slightly greater than male sex in our study, which is in agreement with other authors [3–5], but differs from other studies [2, 6–8]. The higher prevalence of male sex in some studies may be explained by the fact that men usually have poorer oral hygiene habits and are more susceptible to trauma than women [6]. According to the literature, the most frequently affected site is the anterior maxilla [2, 3, 5, 7, 8], which is in agreement with our findings but differs from those reported by Meningaud et al. [6], who reported that the mandible was more frequently affected. The fact that the anterior maxilla is more often affected may be explained by esthetic factors, as patients may wish to preserve their anterior teeth even when endodontic treatment is not adequate [3]. The third and fourth decades of life were the most frequent in our study (Table 4), in agreement with findings in the literature [2, 3, 5, 7, 8].

Dentigerous cysts are defined by Shear as cysts that affect the crown of an unerupted tooth and are attached to its cervical area [13]. Most studies report that dentigerous cysts are the second most prevalent odontogenic cysts [2–7, 9] which was confirmed in our study, in which 22.20% of the cases were dentigerous cysts. A slightly greater number of cysts occurred in women (52%), differently from findings in the literature, which report that men are more frequently affected [2–8]. The mandible was the bone most frequently affected in our study, and the posterior region was the most frequent site, followed by the anterior maxilla, which is in agreement with other studies [2, 3, 7, 8]. Such prevalence may be explained by the large number of impacted mandibular third molars and maxillary canines. Most dentigerous cysts occurred in patients in the second decade of life in this study (Table 4), as well as in the studies conducted by Ochsenius et al. [3], Ledesma Montes et al. [5], Bataineh et al. [7] and Koseoglu et al. [8]. Jones

et al. [2] found a frequency peak in the fifth and sixth decades of life, which differs from findings of other studies in the literature.

Residual cysts are retained radicular cysts from teeth that have been extracted [13]. In our study, residual cysts were the third most frequent type of odontogenic cysts, which is in agreement with findings reported by Varinauskas et al. [9] and Bataineh et al. [7]. However, our results differ from those reported by other authors [2–6], who found that this lesion was the fourth most frequent, because OKCs were included in their studies. Ledesma-Montes et al. [5] found that residual cysts occurred in women more frequently, which differs from our findings and studies in the literature [2–4, 6, 7]. The mandible was slightly more prevalent than other sites in our study, but no specific anatomic site was determined. Jones et al. [2] and Ochsenius et al. [3] found that residual cysts were most frequently found in the anterior maxilla. The diagnosis of this pathology was more prevalent in patients over 80 years old (Table 4), whereas the third, fifth and sixth decades of life were found to be the most frequent in the studies by Ledesma-Montes et al. [5], Ochsenius et al. [3] and Bataineh et al. [7]. The finding that patients with residual cysts are older than patients with radicular cysts may be explained by the fact that cystic lesions are located inside the maxilla, cause no clinical symptoms after tooth extraction, and are only detected months or years later because of secondary infection or as an incidental radiographic finding.

Paradental cysts are inflammatory lesions that usually affect the distal or buccal surface of partially erupted mandibular third molars with a history of pericoronitis. They are also called buccal bifurcation cysts when located on the buccal surface of the permanent mandibular first molar [1]. This type of cysts was the fifth most frequent in this study and accounted for 0.58% of the cases (0.56% with the inclusion of OKC), a lower percentage than the one reported by Jones et al. [2] (5.6%), Ochsenius et al. [3] (3.8%), Mosqueda-Taylor et al. [4] (1.4%) and de Sousa

**Table 4** Prevalence of odontogenic cysts according to age

Cyst	Age <sup>a</sup>							
	0–9 (%)	10–19 (%)	20–29 (%)	30–39 (%)	40–49 (%)	50–59 (%)	60–69 (%)	≥70 (%)
Radicular	1.27	6.79	24.20	33.12	18.25	9.55	4.88	1.91
Dentigerous	8.22	42.46	32.19	10.27	2.74	2.05	2.05	0
Residual	0	0	7.14	21.42	17.86	21.42	7.14	25
Paradental	0	75	0	25	0	0	0	0
Lateral periodontal	0	0	0	50	0	50	0	0
Eruption	100	0	0	0	0	0	0	0

<sup>a</sup> Age expressed in years

et al. [14] (4.3%). No sex predilection was found, but studies in the literature report on a predilection for male sex in some series [2–4, 15], and for female sex in others [14, 16]. Our results showed that these cysts were most prevalent in the second decade of life (Table 4), whereas other studies found the highest prevalence rates in the first [16] and third [14, 15] decades of life. The most frequent site in our study was the posterior mandible, where cysts are associated with the third molar, which is in agreement with findings reported by Philipsen et al. [15] and de Souza et al. [14]. Lacaíta et al. [16] studied a series of patients aged 6–9 years, and found that the first molar was the tooth most frequently associated with this type of cyst. Jones et al. [2] suggested that these cysts are more common than what is found in the literature, which may explain their low prevalence in our study.

Lateral periodontal cysts occur laterally to the root of a vital tooth, do not often cause clinical signs or symptoms, and are thus usually found in routine radiographic examinations [17]. When lesions are polycystic, they are called botryoid odontogenic cysts [1]. Studies in the literature found a frequency of 0.3–8% of all odontogenic cysts [2–7, 18], and only 2 (0.29%) cases were found in our study. A predilection for male sex [2–4, 6, 7, 18] and the premolar region [3, 7, 19] is found in the literature.

Eruption cysts are the equivalent of dentigerous cysts in soft tissues. They develop as the result of the separation of the dental follicle that covers the crown of an erupting tooth that is within soft tissue over the alveolar bone [1]. In agreement with our findings, studies in the literature report a frequency of 0.1–1% of all odontogenic cysts [2–5]. According to the literature, the maxilla [3, 20–22] and men [2, 5, 21, 23] are most frequently affected. They occur in the first decade of life [5, 21, 23] and in white individuals [21, 22] most frequently. Only one case was found in our study: a cyst associated with tooth #21 in an 8-year-old white boy. The small number of eruption cysts found in our study may be explained by the fact that these lesions are not often biopsied because they rupture spontaneously during tooth eruption.

Odontogenic keratocysts used to be classified as odontogenic cysts arising from remnants of the dental lamina [1]. In addition to their marked tendency to recur, their clinical aggressiveness, high mitotic count, and greater epithelial turnover rate indicated that they might be benign cystic tumors [24]. Genetic findings of the Gorlin-Goltz syndrome (nevroid basal cell carcinoma syndrome) and of spontaneous cases of OKC led to the reclassification of these lesions [25]. In 2005, the WHO [11] issued a new classification for odontogenic cysts and tumors, and renamed OKC as keratocystic odontogenic tumors (KOT).

When this study data were collected, the classification by Kramer et al. [12] was usual. Therefore, data about

OKC were collected, but data about sex, ethnicity, site and age are not reported in this study because OKCs, now KOTs, are no longer classified as odontogenic cysts. In this study, no significant differences were found in the prevalence of odontogenic cysts when analyses were conducted with or without OKC (KOT) because their frequency in the records analyzed was low (3.95%). However, if OKCs are excluded from some studies [2–6, 8], the prevalence of other cysts, particularly inflammatory cysts, may be overstated (Table 5). Some studies suggest that the most prevalent developmental cysts, dentigerous cyst, may have an inflammatory origin [13, 26–30], which may indicate that most odontogenic cysts have an inflammatory origin.

The change in the WHO classification [11], in 2005, also affected studies of odontogenic tumors, and the keratocystic odontogenic tumor gained an important role in the prevalence of these lesions. In the study conducted by Jing et al. [31], the inclusion of OKC in the study group revealed that it was the second most prevalent lesion (35.8%), preceded only by ameloblastomas (40.3%).

Most studies do not report on patient ethnicity; therefore, the ethnicity of study populations could not be compared with our findings. However, the similarity between our findings and those reported in the literature suggests that there is no ethnicity effect on the prevalence of odontogenic cysts. Our findings showed that the cysts under study were most predominant in white patients. This finding takes into consideration the fact that 82.39% of the patients were classified as white individuals, which is compatible with the ethnic characteristics of the population in the state of Rio Grande do Sul, where the study was conducted and where 86.5% of the population is white (IBGE) [32].

With the inclusion of OKC, our results showed a greater prevalence of inflammatory cysts (74.3%), similar to the rates reported by Jones et al. [2] (62.28%), Ochsenius et al. [3] (65.7%), Meningaud et al. [6] (58.2%), Bataineh et al. [7] (61.4%) and Koseoglu et al. [8] (58.8%), whereas Ledesma-Montes et al. [5] and Mosqueda-Taylor et al. [4] found a greater frequency of developmental cysts. With the exclusion of OKC from analysis, inflammatory cysts would be the most frequent in all studies.

The socioeconomic conditions of the country where this study was conducted did not seem to affect the frequency of any type of lesion. Studies conducted in the United Kingdom, Chile, France, Turkey and Jordan found a greater frequency of inflammatory cysts, whereas two studies conducted in Mexico found more developmental cysts. However, an individual's socioeconomic situation is an important factor: poorer patients do not have the same level of education and financial resources for conservative treatment as patients who are wealthier, which was demonstrated in a study by Mosqueda-Taylor et al. [4], who



**Table 5** Association between developmental cysts and inflammatory cysts with and without odontogenic keratocyst

Authors	Inflammatory cysts including OKC	Developmental cysts including OKC (Developmental cysts excluding OKC)	Total (%)
Jones et al. [2] (United Kingdom)	67.99% (77.24%)	32.00% (22.75%)	100
Ochsenius et al. [3] (Chile)	65.72% (76.69%)	34.27% (23.30%)	100
Mosqueda-Taylor et al. [4] (Mexico)	43.57% (55.50%)	56.42% (44.49%)	100
Ledesma-Montes et al. [5] (Mexico)	43.75% (53.84%)	56.25% (46.15%)	100
Meningaud et al. [6] (France)	58.12% (71.88%)	41.87% (28.11%)	100
Bataineh et al. [7] (Jordan)	61.46% (65.36%)	38.53% (34.63%)	100
Koseoglu et al. [8] (Turkey)	58.88% (80.30%)	41.11% (19.69%)	100
Our study (Brazil)	74.29% (77.35%)	25.70% (22.64%)	100

OKC = odontogenic keratocyst

Source: Department of Oral Pathology, School of Dentistry, Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

found that patients of a private clinic had more diagnoses of developmental cysts than patients of a public health service, who had more inflammatory cysts. In our study, the prevalence of inflammatory cysts may be attributed to the section of the population assisted at PUCRS, consisting mainly of low-income and low-schooling patients.

In conclusion, this study found a prevalence rate similar to those reported in other studies, in which most odontogenic cysts were inflammatory. This prevalence was greater when OKCs were excluded from the group of cysts under study.

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