

A retrospective study of cysts in the maxillofacial area

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The purpose of this study was to investigate the prevalence of odontogenic cysts in the oral and maxillofacial area. The subjects of this study were diagnosed and treated for cysts in the jaw at Chonnam National University Hospital from January 2013 to December 2017. Patients' information, including age, types and locations of cysts, history of bone grafting, and types of graft material used were recorded by reviewing medical records, clinical examinations, panoramic radiographs, dental computed tomography findings, and biopsy results. Among all 544 cases, the overall male (352, 64.7%) to female (192, 35.3%) ratio was 1.8:1. The age of the patients ranged from 6 to 87 years, with 103 (18.6%) in their 40s, 95 (17.1%) in their 20s–30s, and 90 (16.2%) in their 50s. In the histopathological distribution, the most common cyst type was a radicular cyst (47.6%), while dentigerous cyst (29.4%) was the second most prevalent. The occurrence of the cysts was highest in the posterior mandibular region (42.6%) and the anterior maxillary region (39.9%). Cyst enucleation was the most commonly used treatment option (55.6%), and autogenous bone was the most frequently used bone graft material. In this study, the prevalence of radicular cysts was higher than that of other types of cyst. The prevalence of cysts was higher in older patients than in younger age groups. Treatment of cysts is based on complete enucleation and requires bone grafting, as necessary.

Key Words: Bone grafting, Cyst, Prevalence

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INTRODUCTION

A cyst is one of the most commonly found pathological conditions in the oral and maxillofacial region. A cyst, usually referred to as a follicle, is a cavity surrounded by connective tissue with an epithelial lining surrounded by either soft or hard tissue. Inside the cavity is usually liquid or semi-fluid material. Substances within the cavity cause high osmotic pressure, which leads to growth of the cyst. It is a disease that requires rapid diagnosis and treatment

because it may destroy adjacent bone and soft tissue [1].

Cysts of the jaw are not new lesions, with the mandible and maxilla as the most frequent anatomical sites of cysts [2]. In some cases, jaw cysts become very large and their removal results in facial asymmetry, adjacent neurovascular bundle damage, and permanent malfunction of the peripheral nerve function [3,4].

The odontogenic epithelium in the maxilla and mandible can be transformed in a variety of odontogenic cysts [5,6]. Teeth also influence the spread of infection from pulp or

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periodontal tissue to the alveolar bone. As early as 1903, Oliver extrapolated Sutton's classification of odontomas, wherein cysts were described as variants of odontomes. Inflammation in the upper or lower jaw can be the initiation point of cyst formation in the alveolar process. Formation of a large cystic wall that involves tooth buds, during mixed dentition, can cause the loss of permanent teeth. Elderly patients with large cystic formations in either jaw, in all these condition. Marsupialization is the first option in treatment planning for such cases.

To date, marsupialization and enucleation are the most common treatment options for cystic lesions of the jaw, since they were first introduced by Partsch [7,8]. Owing to the advances in radiographic assessments, including 3-dimensional dental computed tomography (CT) and histopathologic evaluation, individualization of each patient's treatment plan is possible.

However, ongoing changes in our understanding of cysts, especially with the advent of new cystic entities and the reclassification of older ones owing to advances in imaging, histopathological evaluation, diagnosis, and treatment of cystic lesions, make periodic updates necessary. Therefore, the treatment blueprint needs to be embellished by various adjunctive procedures as per the individual patient's needs to result in a comprehensive treatment plan. The individualization of treatment plans based on various clinical, radiological and histological variables is especially pertinent in developing countries, where the clinical course of jaw cysts is relatively longer due to poor awareness, difficult access to health care, and often late diagnosis. Thus, the treatment choices are more difficult to make. Therefore, a clinical study of cysts and an inventory of the various factors affecting choice of treatment are relevant.

Cysts of the oral and maxillofacial region can be classified as developmental cysts and inflammatory cysts. This paper will examine odontogenic cysts that make up more than 70% of developmental cysts. Odontogenic cysts can destroy adjacent tissues, causing absorption or expansion of the jaw, pathological fractures, and facial deformities, which may result in functional or aesthetic defects. Therefore, early diagnosis and treatment of odontogenic cysts is imperative.

For accurate diagnosis and treatment of cysts, using sta-

tistical data, such as sex, age, and sites of prevalence, can be helpful. Data can be useful to assess differences in a statistical study since the statistics associated with this disease may vary depending on race and anatomical region. The purpose of this paper was thus to obtain basic data on the clinical statistics of odontogenic cysts in Korea according to the newly revised World Health Organization (WHO) classification system.

MATERIALS AND METHODS

The subjects of this study were diagnosed and treated for cysts in the jaw at Chonnam National University Hospital from January 2013 to December 2017. A total of 544 patients (mean age: 32.1 years), having been monitored for more than 6 months after surgery with available panoramic radiographs, were reviewed. All patients were examined for types and locations of cysts, bone grafting history, types of graft material, and systemic diseases. This was accomplished by reviewing medical records, clinical examinations, panoramic radiographs, dental CT findings, and biopsy.

Overall, 544 cases, with clinico-radiological diagnosis of a cyst in the oral and maxillofacial region, were selected and treated and the diagnosis was co-related to the eventual histopathological diagnosis. The patients were followed up for at least 6 months (6-12 months). An attempt was made to underline patient and lesion related variables affecting the choice of treatment modality in each case.

Patients were divided into three age groups—pediatric (under 16 years), younger adults (from 17 years to 40 years), and older adults (over 40 years). Depending on the case, surgery was performed under local or general anesthesia and included one of the following treatment modalities: enucleation after marsupialization, enucleation only, and enucleation with bone grafting or resection. The Student-Newman-Keuls method was used for statistical analysis.

RESULTS

Sex and age distribution

The mean age at the time of surgery for the maxillofacial

cystic lesions was 32.1 years (range, 6 to 87 years). Among 544 patients, 352 were male (64.7%) and 192 were female (35.3%) with a ratio of 1.83:1. By age, the number of males was the greatest in the 41–50-year-old (75 cases, 20.7%) group and the number of females was the greatest in the 21–30-year-old (46 cases, 24.0%) group (Table 1).

The types of cysts, mean age and sex of patients, and most affected sites of cysts in the pediatric age group are listed in Table 2. In this group (n=54), the most common cysts were dentigerous cysts (40.7%), followed by radicular cysts (24.1%), and simple bone cysts (22.2%). The mean ages were 11, 8, and 14 years for dentigerous cyst, radicular cyst, and simple bone cyst, respectively. The male to female ratio was 1.35:1 in the pediatric age group and 1.89:1 in the adult group. This difference was statistically significant ($p < 0.05$) (Table 2).

Male patients were the most prevalent in the 41–87-year-old (56.5%) age group. Conversely, the 17–40-year-old group (50.0%) had the highest number of female patients (Table 1).

The posterior mandibular area was the most common site affected with 236 cases (42.6%). The second most common site was the anterior maxillary area with 221 lesions (39.9%). In 12 cases (2.2%), simultaneous multiple cystic le-

sions were observed in the maxilla and mandible (Table 3).

The posterior mandibular area was the most common site for a cyst (236 cases, 42.6%), followed by the maxillary anterior area (221 cases, 39.9%), the maxillary posterior area (47 cases, 8.5%), and the mandibular anterior area (38 cases, 6.9%). Multiple cystic lesions were observed in 12 patients (2.2%) (Table 3).

Treatment

The surgical treatment modalities of the jaw cysts are presented in Table 4. Cyst enucleation and bone graft were performed in 375 cases (68.9%), followed by enucleation in only 95 cases (17.5%). Marsupialization alone was performed in 32 patients (5.9%) and enucleation in 22 cases with bone graft after 6 to 12 months of marsupialization.

Bone graft materials were used as autograft (52.2%), allograft (11.0%), and xenograft (8.9%) and in 148 cases (27.2%), no bone graft was used (Table 5).

Table 1. Sex distribution (n=544)

Age (y)	Male	Female	Total
6–16	31 (8.8)	23 (12.0)	54 (9.9)
17–40	122 (34.7)	96 (50.0)	218 (40.1)
41–87	199 (56.5)	73 (38.0)	272 (50.0)
Total	352 (100)	192 (100)	544 (100)

Values are presented as number (%).

Table 2. Histopathologic results of pediatric patients (n=54)

Histopathology	Male	Female	Total
Radicular cyst	7 (22.6)	6 (26.12)	13 (24.1)
Dentigerous cyst	12 (38.7)	10 (43.5)	22 (40.7)
Nasopalatine duct cyst	2 (6.5)	1 (4.3)	3 (5.5)
Odontogenic keratocyst	1 (3.2)	0 (0)	1 (1.9)
Simple bone cyst	7 (22.6)	5 (21.7)	12 (22.2)
Ameloblastoma	1 (3.2)	0 (0)	1 (1.9)
Etc.	1 (3.2)	1 (4.3)	2 (3.7)
Total	31 (100)	23 (100)	54 (100)

Values are presented as number (%).

Table 3. Site distribution

Site	All patients (n=544)	Pediatric patient (n=54)		Younger adult group 17–40 years (n=218)		Older adult group 41–87 years (n=272)	
	Cases	Male	Female	Male	Female	Male	Female
Maxillary anterior	208 (38.2)	8 (25.8)	6 (26.1)	56 (45.9)	32 (33.3)	85 (42.7)	21 (28.8)
Maxillary posterior	46 (8.5)	2 (6.5)	2 (8.7)	8 (6.5)	15 (15.6)	12 (6.1)	7 (9.6)
Mandibular anterior	37 (6.8)	9 (29.0)	4 (17.4)	4 (3.3)	4 (4.2)	10 (5.0)	6 (8.2)
Mandibular posterior	241 (44.3)	10 (32.2)	10 (43.5)	51 (41.8)	42 (43.8)	90 (45.2)	38 (52.0)
Multiple area	12 (2.2)	2 (6.5)	1 (4.3)	3 (2.5)	3 (3.1)	2 (1.0)	1 (1.4)
Total	544 (100)	31 (100)	23 (100)	122 (100)	96 (100)	199 (100)	73 (100)

Values are presented as number (%).

Table 4. Treatment methods (n=544)

Treatment method	Case
Enucleation only	95 (17.5)
Enucleation and bone graft	375 (68.9)
Marsupialization only	32 (5.9)
Marsupialization and enucleation with bone graft	22 (4.0)
Other treatments (surgical exploration, Cald-Well Luc operation)	20 (3.7)
Total	544 (100)

Values are presented as number (%).

Table 5. Bone graft materials

Bone graft material	Case
Autograft	284 (52.2)
Allograft	60 (11.0)
Xenograft	48 (8.9)
Alloplast or synthetic graft	4 (0.7)
None	148 (27.2)
Total	544 (100)

Values are presented as number (%).

Table 6. Histopathologic results (n=554)

Histopathologic result	Male	Female	Total
Radicular cyst	161 (45.7)	98 (51.1)	259 (47.6)
Dentigerous cyst	116 (33.0)	44 (22.9)	160 (29.4)
Nasopalatine duct cyst	41 (11.6)	16 (8.3)	57 (10.5)
Odontogenic keratocyst	8 (2.3)	11 (5.7)	19 (3.5)
Simple bone cyst	11 (3.1)	7 (3.6)	18 (3.3)
Ameloblastoma	6 (1.7)	3 (1.6)	9 (1.7)
Other cysts	9 (2.6)	13 (6.8)	22 (4.0)
Total	352 (100)	192 (100)	544 (100)

Values are presented as number (%).

DISCUSSION

Cystic lesions of the jaws can be either odontogenic or non-odontogenic, and developmental or inflammatory in origin. In the present study, 46.9% of cysts were developmental while 45.7% were inflammatory in origin (Table 6). This is in general agreement with the distribution of cyst types found in previously published large studies [9]. However, when looking separately at the pediatric and adult groups (under 16 years and 17–40 years, respectively), a difference in the distribution of radicular cysts, an inflammatory cyst (24.1% and 53.2%, respectively), and dentiger-

Table 7. Histopathologic results of the 17–40-year-old adult group (n=218)

Histopathology	Male	Female	Total
Radicular cyst	65 (53.3)	51 (53.1)	116 (53.2)
Dentigerous cyst	35 (28.7)	18 (18.8)	53 (24.4)
Nasopalatine duct cyst	11 (9.0)	11 (11.5)	22 (10.1)
Odontogenic keratocyst	2 (1.6)	5 (5.2)	7 (3.2)
Simple bone cyst	3 (2.5)	1 (1.0)	4 (1.8)
Ameloblastoma	2 (1.6)	2 (2.1)	4 (1.8)
Etc.	4 (3.3)	8 (8.3)	12 (5.5)
Total	122 (100)	96 (100)	218 (100)

Values are presented as number (%).

Table 8. Histopathologic results of the 41–87-year-old adult group (n=272)

Histopathology	Male	Female	Total
Radicular cyst	89 (44.7)	41 (56.1)	130 (47.8)
Dentigerous cyst	69 (34.7)	16 (21.9)	85 (31.3)
Nasopalatine duct cyst	28 (14.1)	4 (5.5)	32 (11.8)
Odontogenic cyst	5 (2.5)	6 (8.2)	11 (4.0)
Simple bone cyst	1 (0.5)	1 (1.4)	2 (0.7)
Ameloblastoma	3 (1.5)	1 (1.4)	4 (1.5)
Etc.	4 (2.0)	4 (5.5)	8 (2.9)
Total	199 (100)	73 (100)	272 (100)

Values are presented as number (%).

ous cyst, a developmental cyst (40.7% and 24.4%, respectively), was noted. This finding is in agreement with those in earlier reports (Table 2, 7, 8) [10–15].

The difference in prevalence of developmental cysts is most likely related to the fact that during the pediatric period, the jaws are involved in profound developmental processes. These include growth of the maxillofacial skeleton and development of the primary and permanent dentition, all of which can be associated with cyst formation. The difference in distribution of inflammatory cysts may be because radicular cysts arising from primary teeth are very rare [16]. Radicular cysts arising from permanent teeth are also infrequent in pediatric patients, because radicular cysts arise from epithelial residues in the periodontal ligament as a result of inflammation that follows necrosis of the dental pulp. Recently it was shown that erupted permanent teeth in pediatric patients are usually intact.

Usually, clinical manifestation of infection around the cyst is closely related to acute or chronic inflammation at

the cystic wall. The destruction of the epithelial lining of the cyst wall, regardless of the origin, gives rise to a cyst wall with granulation tissue.

Of the 54 pediatric cases in our series, were male and female, providing a male to female ratio of 1.7. In contrast, of the adult cases, were male and were female, with a male to female ratio of 1.9. This in agreement with the reported distribution of cysts in the general population, where there is a significant difference in the sex-related distribution, with male predominance [17-19].

The greater prevalence in adult males may be because they are more likely to neglect their teeth or are more likely to sustain trauma to their teeth compared to females, all of which can be involved in the etiology underlying cyst formation [16].

For most of the cysts, panoramic radiographs and dental CT were adequate imaging modalities. The dental CT, originally designed for implant dentistry, has proven to be useful in the evaluation of jaw abnormality and pathology. Using this, anatomic structures, such as the mandibular canal, mental foramen, incisive canal, and maxillary sinus, can be seen in cross-section. Dental CT has also been shown to be superior to plain film radiography in demonstrating cystic lesions of the jaws and in evaluating bone regeneration following marsupialization of jaw cysts [20-22]. It also allows planning of the surgical approach with least morbidity to the adjacent anatomic structures.

The treatment objective is restoring the morphology and function of the affected area. There are two basic surgical procedures, namely marsupialization (decompression) and enucleation. Marsupialization, a relatively simple procedure, consists of surgically producing a "window" in the cystic wall to relieve intra-cystic tension. After this, the cystic cavity slowly decreases in size. The cavity is lightly packed with paraffin gauze until the junction between the cystic lining and the oral mucosa has healed. Three to six months later, enucleation is performed [23].

Notable disadvantages of the technique are: (a) it is a two-stage surgical procedure, (b) pathological tissue is left behind and a more sinister pathological process (i.e., squamous cell carcinoma) may be overlooked [24], and (c) in large cystic cavities, it takes a long time for the bone to regenerate.

Cysts of the jaw are commonly found lesions and clinically important pathological entities due to their invasive character. Among them, the odontogenic cyst is capable of destroying surrounding tissues, which may cause absorption or expansion of the jaw, pathological fracture, and facial deformities leading to functional and aesthetic defects. Thus, it is very important to diagnose and treat odontogenic cysts in the early stages. Cysts are classified according to their origins, and most scholars use the WHO classification. This study was also based on the WHO classification system [25,26].

Radiological images of cystic lesions and patient's age were found to be the two most important variables affecting treatment planning, while factors such as size and site of the lesion did not have any major impact on treatment planning.

Age as the most important clinical variable attests to the importance given by operators to the patients' quality of life, while considering the options with respect to recurrence or future treatment [27,28]. History of previous surgery, on the other hand, is taken into account by operators and is an indication to treat the lesion aggressively, giving precedence to longevity and prognosis of treatment.

Enucleation was validated as the most suitable modality for almost all cysts, with various adjunctive procedures (as deemed necessary per case). Relatively complicated procedures were chosen more due to the age, clinical presentation, relatively aggressive clinical course, or poorly accessible site of lesions, rather than the histopathological diagnosis, further underlining the need for and relevance of custom-made treatment plans for each patient.

The treatment results were satisfactory in all cases, justifying the choice of treatment modalities, though the study period was inadequate to observe long term recurrence or neoplastic transformations of the lesions [29,30].

Regardless of the type of cyst, the largest number of patients by age group was in their 40s (18.6%), followed by 20s (17.1%) and 30s (17.1%) and then 50s, 10s, and 60s. The prevalence of cysts in the 20-40-year-old group was more than half (52.8%) that in the entire cohort. Therefore, the highest occurrence of cysts in the jaw can be estimated to be somewhere between age groups of 20s and 40s. In the study by Arotiba et al. [31], patients in their 20s had the

greatest prevalence of cysts (44.4%). Observed that patients in their 20s had the highest prevalence among the African populations (44%). The above two studies demonstrate somewhat different results from the data retrieved in this study.

The pathologic distribution shows that the radicular cyst is the most prevalent (47.6%), followed by dentigerous cyst (29.4%), nasopalatine duct cyst (10.5%), and odontogenic keratocyst (3.5%). The most common cyst in all countries was the radicular cyst, followed by the dentigerous cyst, the odontogenic keratocyst, and the residual cyst. However, the results of this study show that the distribution of the residual cyst and the odontogenic keratocyst were similar, and a study from Spain showed that the distribution of the residual cyst was higher than that of odontogenic keratocyst [6]. These results suggest that the incidence of the odontogenic keratocyst varies according to race and geography.

The most commonly occurring sites for cysts were the posterior mandibular area (42.6%) and the anterior maxillary area (39.9%). A possible explanation for why radicular cysts are frequently found in the anterior maxillary area in particular is that the maxillary anterior area is a common site for trauma, which therefore may lead to a radicular cyst with the progression of necrosis [32].

Bone grafts can be used where a bone defect is seen to improve healing of the bone after cyst enucleation. There are several grafting materials available, but fresh autogenous bone graft is known to have the best results. Moreover, the iliac bone is a preferred donor site due to its good accessibility and quality [14].

Based on the clinical and histopathological findings demonstrated in this study, it is essential that cystic lesions be enucleated if there is no fatal damage to the neighboring anatomical structures and bone. Further, more long term follow up of cystic lesions is advised, especially for dentigerous cysts and odontogenic keratocysts.

In this study, the prevalence rate of radicular cyst was higher than that of other types of cysts. Further, the prevalence of cysts was higher in older patients, and the prevalence of radicular cysts was high among older patients, while the prevalence of dentigerous cysts was high among younger patients. Treatment of cysts should be based on

complete enucleation and bone grafting should be employed as necessary.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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