Spectrum of Reactive and Neoplastic Oral Lesions in Children: A Retrospective Analysis

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ABSTRACT:

Background: Oral lesions in the pediatric population encompass a wide and heterogeneous spectrum ranging from reactive, inflammatory, and traumatic lesions to benign and malignant neoplasms. Despite their clinical and histopathological diversity, these lesions remain undercharacterized in pediatric cohorts across the Arabian Gulf region, with limited institutional data available to guide clinical decision-making and surveillance strategies.

Objective: To analyze the frequency, distribution, clinicopathological characteristics, and histopathological patterns of reactive and neoplastic oral lesions excised from pediatric patients over a defined retrospective period at a tertiary dental institution in Saudi Arabia.

Methods: A retrospective analysis was performed on biopsy records of pediatric patients aged 0–18 years presenting with oral soft tissue and hard tissue lesions over a 10-year study period. Data including patient age, sex, anatomical site, clinical presentation, and definitive histopathological diagnosis were extracted and categorized into reactive lesions, cysts, benign neoplasms, and malignant neoplasms. Frequencies and proportions were computed and analyzed.

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Results: A total of 248 biopsy specimens from pediatric patients were analyzed. Reactive lesions constituted the largest diagnostic category (58.5%), with pyogenic granuloma being the most prevalent entity (22.6%). Cysts accounted for 18.1% of cases, predominantly odontogenic keratocysts and dentigerous cysts. Benign neoplasms comprised 19.8%, while malignant neoplasms were rare, representing 3.6% of all cases. The gingiva and oral mucosa were the most frequently involved sites. Males were slightly more affected than females (ratio 1.3:1).

Conclusion: Reactive lesions dominate the spectrum of pediatric oral biopsies, though neoplastic lesions are not uncommon and require vigilant clinical and histopathological evaluation. Early biopsy and accurate pathological diagnosis are essential for appropriate management and improved outcomes in pediatric patients.

Keywords: oral lesions, pediatric dentistry, reactive lesions, oral neoplasms, oral biopsy, pyogenic granuloma, odontogenic cysts, Saudi Arabia.

Introduction

Oral lesions in children represent a diagnostically diverse and clinically significant group of conditions encountered in both general dental practice and specialized pediatric dentistry settings. The spectrum encompasses reactive and inflammatory lesions arising in response to local irritants, developmental cysts of odontogenic and non-odontogenic origin, benign proliferative neoplasms, and, although rarely, malignant neoplasms of oral cavity [1]. Understanding the relative frequency, demographic distribution, and histopathological patterns of these lesions is critically important for timely diagnosis, appropriate treatment planning, and the prevention of complications that can affect developing dentition, maxillofacial growth, and overall pediatric health [2].

Reactive oral lesions are the most frequently encountered soft tissue lesions in children and adolescents. These include pyogenic granuloma, peripheral giant cell granuloma, peripheral ossifying fibroma, mucocele, fibroma, and papilloma, all of which typically arise secondary to chronic mechanical irritation, poor oral hygiene, hormonal influences, or minor trauma [3]. Though histologically benign and often amenable to simple excision, reactive lesions may recur if underlying etiological factors are not addressed. Their clinical appearance may occasionally mimic more serious neoplastic conditions, necessitating histopathological confirmation in every case [4].

Odontogenic cysts constitute another major category in pediatric oral pathology. Dentigerous cysts, odontogenic keratocysts, radicular cysts, and eruption cysts are among the most commonly reported entities in younger patients [5]. Left untreated, larger cysts may cause significant bone resorption, displacement of developing tooth buds, pathological fracture of the jaw, and subsequent disturbances in facial growth and development [6]. Early radiographic detection and histopathological analysis remain the cornerstone of management for this lesion category.

Benign neoplasms of the oral cavity in children include ameloblastoma, odontoma, neurofibroma, lymphangioma, hemangioma, and pleomorphic adenoma of minor salivary glands, among others [7]. Although benign in biological behavior, certain neoplasms such as ameloblastoma carry considerable potential for local tissue destruction and recurrence if inadequately treated. Comprehensive surgical management guided by precise histopathological diagnosis is therefore essential.

Malignant oral neoplasms in the pediatric age group are exceedingly rare but of paramount clinical importance [8]. Entities such as rhabdomyosarcoma, Burkitt lymphoma, and squamous cell carcinoma, though uncommon in this demographic, carry significant morbidity and mortality when diagnosis is delayed. A high index of clinical suspicion, combined with prompt referral

and histopathological workup, is essential to avoid diagnostic delay in these potentially life-threatening conditions [9].

Epidemiological data regarding pediatric oral lesions vary considerably across geographic regions, institutional settings, and study methodologies. Several studies from South Asia, Southeast Asia, Europe, and North America have documented the prevalence and distribution of these lesions in children [10]. However, data from the Arabian Gulf region, including Saudi Arabia, remain relatively sparse, with most existing literature focused on adult populations or mixed-age cohorts [11]. Establishing region-specific epidemiological benchmarks is vital for the development of targeted public health and clinical dental strategies tailored to the local pediatric population.

The present retrospective study was therefore undertaken to systematically analyze the spectrum of reactive and neoplastic oral lesions diagnosed histopathologically in pediatric patients at a tertiary dental institution in Saudi Arabia over a 10-year period. The study aims to characterize the frequency, demographic distribution, anatomical site predilection, and histopathological subtypes of these lesions, providing data that may inform clinical practice, surgical planning, and future prospective research in pediatric oral pathology within the region.

Methodology

This retrospective study was conducted at the Department of Oral and Maxillofacial Pathology and Oral Diagnostic Sciences at a tertiary dental institution in Saudi Arabia. The study protocol was reviewed and approved by the Institutional Review Board prior to commencement of data collection. Patient confidentiality was maintained in accordance with institutional ethical guidelines throughout the study.

All biopsy records and histopathological reports of pediatric patients aged 0 to 18 years registered at the institution over a consecutive 10-year period were reviewed. Only cases in which a definitive histopathological diagnosis had been rendered and documented were included in the analysis. Cases with incomplete clinical data, unavailable biopsy material, or inconclusive histopathological findings were excluded from the study.

Data extracted for each included case comprised patient age at the time of biopsy, biological sex, anatomical site of the lesion, clinical presentation including size and surface characteristics, symptom profile, duration of lesion prior to clinical presentation, and the definitive histopathological diagnosis. All pathological diagnoses were verified against the original archived hematoxylin and eosin-stained sections, and special stains were reviewed where relevant.

Lesions were categorized into four major diagnostic groups: (1) reactive and inflammatory lesions, including pyogenic granuloma, peripheral giant cell granuloma, peripheral ossifying fibroma, fibrous hyperplasia, mucocele, and papilloma; (2) odontogenic and non-odontogenic cysts, including dentigerous cysts, odontogenic keratocysts, radicular cysts, and eruption cysts; (3) benign neoplasms, encompassing ameloblastoma, odontoma, neurofibroma, hemangioma, lymphangioma, and pleomorphic adenoma; and (4) malignant neoplasms, including rhabdomyosarcoma, lymphoma, and squamous cell carcinoma.

Anatomical sites were recorded as gingiva, tongue, buccal mucosa, lip, floor of the mouth, palate, alveolar ridge, and jaw bones (mandible and maxilla). Age was further stratified into three subgroups for analysis: 0 to 6 years (primary dentition age), 7 to 12 years (mixed dentition age), and 13 to 18 years (permanent dentition and adolescent age).

Data were tabulated and analyzed using SPSS Statistics version 26.0. Descriptive statistics including frequencies and percentages were calculated for all categorical variables. The Chi-square test was used to assess associations between lesion categories and demographic variables including sex and age group. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 248 biopsy specimens from pediatric patients met the inclusion criteria and were analyzed in this study. Of these, 139 specimens (56.0%) were

from male patients and 109 (44.0%) from female patients, yielding a male-to-female ratio of 1.3:1. The mean age at the time of biopsy was 11.4 ± 3.8 years. The adolescent age group (13–18 years) accounted for the highest proportion of cases (44.8%), followed by the mixed dentition group (7–12 years) at 39.5%, and the primary dentition group (0–6 years) at 15.7%.

Table 1: Age and Sex Distribution of Pediatric Patients with Oral Lesions (n = 248)

Age Group	Male n (%)	Female n (%)	Total n (%)
0–6 years	23 (16.5%)	16 (14.7%)	39 (15.7%)
7–12 years	55 (39.6%)	43 (39.4%)	98 (39.5%)
13–18 years	61 (43.9%)	50 (45.9%)	111 (44.8%)
Total	139 (56.0%)	109 (44.0%)	248 (100%)

Chi-square analysis revealed no statistically significant difference in sex distribution across age groups (p = 0.87).

Reactive and inflammatory lesions constituted the most prevalent diagnostic category, accounting for 145 of the 248 cases (58.5%). Among these, pyogenic granuloma was the single most frequent diagnosis, comprising 56 cases (22.6% of total). Mucocele was the second most common reactive entity with 31 cases (12.5%), followed by peripheral ossifying fibroma (17 cases; 6.9%), fibrous hyperplasia (16 cases; 6.5%), peripheral giant cell granuloma (14 cases; 5.6%), and oral papilloma (11 cases; 4.4%). The distribution of individual reactive lesions is presented in Table 2.

Table 2: Distribution of Reactive and Inflammatory Oral Lesions in Pediatric Patients

Lesion Type	Number of Cases	Percentage of Total (%)
Pyogenic Granuloma	56	22.6%
Mucocele	31	12.5%
Peripheral Ossifying Fibroma	17	6.9%
Fibrous Hyperplasia	16	6.5%
Peripheral Giant Cell Granuloma	14	5.6%
Oral Papilloma	11	4.4%
Total Reactive Lesions	145	58.5%

Reactive lesions were predominantly identified in the gingiva and oral mucosa.

Odontogenic and non-odontogenic cysts represented 18.1% of all cases (n = 45). Dentigerous cysts were the most frequently encountered cystic lesion (n = 18; 7.3%), followed by odontogenic keratocysts (n = 13; 5.2%), radicular cysts (n = 9; 3.6%), and eruption cysts (n = 5; 2.0%). The detailed breakdown of cystic lesions is provided in Table 3.

Table 3: Distribution of Cystic Lesions in Pediatric Patients

Cyst Type	Number of Cases	Percentage of Total (%)
Dentigerous Cyst	18	7.3%
Odontogenic Keratocyst	13	5.2%
Radicular Cyst	9	3.6%
Eruption Cyst	5	2.0%
Total Cystic Lesions	45	18.1%

Mandible was the predominant location for dentigerous cysts and odontogenic keratocysts.

Benign neoplasms comprised 49 cases (19.8%). Odontomas were the most common benign neoplastic entity (n = 18; 7.3%), followed by ameloblastoma (n = 12; 4.8%), hemangioma (n = 9; 3.6%), neurofibroma (n = 5; 2.0%), lymphangioma (n = 3; 1.2%), and pleomorphic adenoma (n = 2; 0.8%). Malignant neoplasms were identified in 9 cases (3.6%), including rhabdomyosarcoma (n = 4; 1.6%), non-Hodgkin lymphoma (n = 3; 1.2%), and squamous cell carcinoma (n = 2; 0.8%). The distribution of all neoplastic lesions is summarized in Table 4.

Table 4: Distribution of Benign and Malignant Neoplasms in Pediatric Patients

Lesion Type	Number of Cases	Percentage of Total (%)
Odontoma	18	7.3%
Ameloblastoma	12	4.8%
Hemangioma	9	3.6%
Neurofibroma	5	2.0%
Lymphangioma	3	1.2%
Pleomorphic Adenoma	2	0.8%
Rhabdomyosarcoma	4	1.6%
Non-Hodgkin Lymphoma	3	1.2%
Squamous Cell Carcinoma	2	0.8%
Total Neoplastic Lesions	58	23.4%

Rhabdomyosarcoma was predominantly observed in the 0–12 years age group.

The gingiva was the most frequently involved anatomical site overall (34.3%), followed by the buccal mucosa (21.4%), tongue (15.3%), lip (10.9%), palate (8.1%), alveolar ridge (5.2%), and floor of the mouth (4.8%). The jaw bones (mandible and maxilla) were specifically involved in cystic and intraosseous neoplastic lesions. Anatomical site distribution is detailed in Table 5.

Table 5: Anatomical Site Distribution of Oral Lesions

Anatomical Site	Number of Cases	Percentage (%)
Gingiva	85	34.3%
Buccal Mucosa	53	21.4%
Tongue	38	15.3%
Lip	27	10.9%
Palate	20	8.1%
Alveolar Ridge	13	5.2%
Floor of Mouth	12	4.8%
Total	248	100%

Jaw bone lesions (cysts and intraosseous neoplasms) are included within alveolar ridge and gingiva categories.

Summary of overall lesion category distribution is presented in Table 6 for quick reference.

Table 6: Overall Distribution of Oral Lesion Categories in Pediatric Patients

Lesion Category	Number of Cases	Percentage (%)
Reactive / Inflammatory Lesions	145	58.5%
Odontogenic / Non-odontogenic Cysts	45	18.1%
Benign Neoplasms	49	19.8%
Malignant Neoplasms	9	3.6%
Total	248	100%

Reactive lesions were the predominant category across all age groups and anatomical sites.

Discussion

The present retrospective study provides a comprehensive clinicopathological profile of oral lesions in pediatric patients at a tertiary dental institution in Saudi Arabia, one of relatively few such institutional analyses from the Arabian Gulf region. The overall distribution observed, with reactive lesions predominating, followed by benign neoplasms, odontogenic cysts, and a small but clinically significant subset of malignant neoplasms, is broadly consistent with findings reported in similar retrospective studies conducted internationally, while also revealing certain region-specific patterns worthy of discussion.

The predominance of reactive and inflammatory lesions, constituting 58.5% of all cases, aligns closely with findings from comparable studies. Lawoyin et al. [12] and Zain et al. [13] similarly reported reactive lesions as the most prevalent category in pediatric biopsy series, with frequencies ranging between 50% and 65% across different institutional settings. The primacy of pyogenic granuloma (22.6% of all cases in the present series) is well supported in the literature. This lesion arises in response to chronic local irritation, dental plaque accumulation, and calculus deposits, and its high prevalence in the adolescent age group reflects the compounding influence of hormonal changes that augment angioproliferative responses to local irritants during puberty [14]. The predominant gingival location observed in our cohort is consistent with established anatomical predilection patterns for pyogenic granuloma.

Mucocele as the second most common reactive entity (12.5%) underscores the clinical significance of minor salivary gland injuries in the pediatric oral cavity. The lip, particularly the lower lip, is the characteristically affected site due to its vulnerability to habitual biting and minor trauma [15]. Early recognition and complete excision remain the treatment of choice, and clinicians should be aware of the risk of recurrence if the feeding duct and associated minor salivary gland acini are not completely removed. The present series encountered no cases of mucocele transformation, consistent with its uniformly benign natural history.

Peripheral ossifying fibroma and peripheral giant cell granuloma, both reactive gingival lesions, constituted 6.9% and 5.6% of all cases respectively. These lesions share a similar clinical appearance characterized by gingival overgrowth, red-to-purple coloration, and occasional bleeding on provocation, yet differ substantially in histopathological composition and clinical behavior [16]. Peripheral ossifying fibroma demonstrates greater recurrence potential compared to pyogenic granuloma and requires thorough scaling of the adjacent teeth and elimination of the local irritant at the time of excision. Peripheral giant cell granuloma, although histologically rich in osteoclast-like giant cells, rarely causes underlying bone destruction in pediatric patients and responds favorably to conservative excision [17].

Odontogenic cysts accounted for 18.1% of the total lesion burden, with dentigerous cysts (7.3%) and odontogenic keratocysts (5.2%) being the most prevalent entities. These findings are consistent with reports from El-Naggar et al. [18] and Philipsen and Reichart [19], who identified dentigerous cysts as the most common developmental odontogenic cyst in pediatric and adolescent populations. The characteristically close anatomical relationship of dentigerous cysts with the crown of unerupted permanent teeth, most frequently the mandibular third molar and maxillary canine, underscores the need for routine panoramic radiographic surveillance during the mixed dentition period to enable early detection and timely intervention.

Odontogenic keratocysts, now reclassified as keratocystic odontogenic tumors by some authorities due to their biologically active nature and propensity for recurrence, represented the second most common cystic entity [20]. Their relatively higher prevalence in the adolescent subgroup is consistent with their known peak incidence during the second and third decades of life. The potential association of multiple odontogenic keratocysts with nevoid basal cell carcinoma syndrome (Gorlin-Goltz syndrome) should prompt clinicians to conduct a thorough systemic review when multiple keratocysts are identified in young patients [21].

Among benign neoplasms, odontoma was the most frequently encountered entity (7.3%), consistent with its established status as the most common odontogenic tumor in pediatric populations worldwide [22]. Compound odontomas were proportionally more common than complex odontomas in the present series, a distribution pattern consistent with published literature. Though odontomas are considered hamartomatous rather than truly neoplastic, their capacity to impede tooth eruption and cause dentigerous cyst formation necessitates early radiographic diagnosis and surgical removal. Ameloblastoma (4.8%) was the most prevalent true odontogenic neoplasm in our cohort, predominantly involving the mandibular molar-ramus region, and requiring comprehensive surgical management to prevent local destruction and recurrence.

Malignant neoplasms, though accounting for only 3.6% of cases, represent the most clinically critical subset due to their associated morbidity and mortality. Rhabdomyosarcoma was the most frequent malignant entity (1.6%), a finding concordant with its established status as the most common soft tissue sarcoma in children affecting the head and neck region [23]. Non-Hodgkin lymphoma and squamous cell carcinoma together accounted for the remaining malignant cases. The rarity of oral squamous cell carcinoma in the pediatric population underscores the need for heightened vigilance when persistent, non-healing oral ulcers or masses are encountered in young patients without obvious reactive etiology. Prompt

biopsy, multidisciplinary oncological evaluation, and timely referral are essential components of management for suspected malignancy in this age group [24].

The slight male predominance (male-to-female ratio 1.3:1) observed in the present study is consistent with several published series, though the reasons for this disparity are not fully established. Higher rates of traumatic injury, greater exposure to local irritants, and potentially lower uptake of preventive dental services among male children have been proposed as contributing factors [25]. The anatomical preponderance of lesions at the gingival site reflects the common etiological thread of local irritation, plaque, and calculus accumulation, reinforcing the paramount importance of oral hygiene education and preventive dental programs in the pediatric population.

The findings of this study have important implications for dental practice and pediatric oral health policy in Saudi Arabia. The high frequency of reactive lesions amenable to conservative management highlights the need for widespread oral health education targeting parents and school-aged children. The significant proportion of cystic and neoplastic lesions requiring surgical intervention underlines the necessity of accessible oral surgery and oral pathology services within tertiary dental institutions. Routine panoramic radiographic examinations during key developmental milestones should be incorporated into national pediatric dental care protocols to facilitate early detection of jaw lesions and cysts before they cause irreversible tissue damage.

Conclusion

The spectrum of oral lesions in the pediatric population is broad and clinically diverse, encompassing reactive, cystic, benign neoplastic, and malignant entities. Reactive and inflammatory lesions, particularly pyogenic granuloma and mucocele, dominate the histopathological profile, reflecting the central role of local irritants and minor trauma in pediatric oral pathology. Odontogenic cysts and benign neoplasms constitute a substantial proportion of cases requiring surgical management, while malignant neoplasms, though rare, demand prompt diagnosis and multidisciplinary intervention.

Region-specific data from Saudi Arabia confirm patterns broadly consistent with international literature, while underscoring the need for targeted preventive dental programs, routine radiographic surveillance during critical developmental periods, and improved access to oral pathology diagnostic services within the region. Histopathological evaluation remains indispensable for the definitive diagnosis of oral lesions in children and should be regarded as a standard component of management for any excised oral lesion in this age group. Future prospective multicenter studies with standardized diagnostic criteria and larger patient cohorts will further refine the epidemiological profile of pediatric oral lesions in the Gulf region and inform evidence-based clinical guidelines.

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