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Surgical Management of Pediatric Odontogenic Tumors: Clinical, Radiographic, and Histopathological Outcomes

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ABSTRACT:

Background:

Pediatric odontogenic tumors are uncommon lesions that may present with variable clinical and radiographic features, making accurate diagnosis and selection of an appropriate surgical approach important for achieving favorable outcomes while minimizing morbidity.

Aim:

The present study aimed to evaluate the clinical, radiographic, histopathological, and postoperative outcomes of surgically managed pediatric odontogenic tumors and to assess the relationship between surgical approach, radiographic characteristics, and tumor recurrence.

Materials and Methods:

A total of 30 pediatric patients with histopathologically diagnosed odontogenic tumors were evaluated. Demographic characteristics, anatomical site, clinical presentation, radiographic features, histopathological diagnosis, surgical procedure, early postoperative complications, treatment response, and recurrence were assessed. Descriptive statistics were expressed as mean ± standard deviation or frequency and percentage. Associations between categorical variables were evaluated using the chi-square test or Fisher's exact test, with statistical significance established at $p < 0.05$.

Results:

The study population had a mean age of 12.7 ± 3.1 years, with males comprising 60.0% of the participants. The mandible was involved in 76.7% of cases, with the posterior mandible being the most frequently affected site (53.3%). Painless swelling was the predominant clinical presentation (66.7%). Radiographically, unilocular radiolucency was

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most common (60.0%), while 83.3% of lesions had well-defined borders and 63.3% demonstrated cortical expansion. Unicystic ameloblastoma was the most frequent histopathological diagnosis (26.7%), followed by adenomatoid odontogenic tumor (20.0%) and odontoma (16.7%). Enucleation with curettage was the most commonly performed surgical procedure (43.3%), followed by enucleation alone (23.3%). Primary bone healing without complications occurred in 83.3% of cases. Overall, complete clinical and radiographic resolution was achieved in 90.0% of patients, while recurrence occurred in 3.3% of cases. Recurrence was not significantly associated with conservative versus radical/segmental surgery ($p = 0.540$). However, cortical expansion ($p = 0.001$) and root resorption/displacement ($p = 0.036$) were significantly associated with recurrence.

Conclusion:

Pediatric odontogenic tumors in this study showed a predominance of mandibular involvement and commonly presented as painless swelling with well-defined, predominantly unilocular radiolucent lesions. Conservative surgical management was frequently used and was associated with favorable healing and treatment outcomes. Although overall recurrence was low, selected radiographic features, particularly cortical expansion and root resorption or displacement, were associated with recurrence and may be useful in postoperative risk assessment and follow-up planning.

INTRODUCTION

Odontogenic tumors constitute a diverse group of lesions arising from the cellular components involved in tooth formation, including odontogenic epithelium and ectomesenchymal or mesenchymal tissues. Although these lesions are relatively uncommon during childhood, their occurrence in growing jaws can have important consequences for normal craniofacial development. Depending on their size and biological behavior, odontogenic tumors may interfere with tooth eruption, alter the developing dentition, expand the jaws, produce facial asymmetry, and cause functional or esthetic concerns. Early recognition and appropriate management are therefore essential to reduce their impact on the developing dentofacial structures [1].

The clinical characteristics of pediatric odontogenic tumors are variable and are influenced by the histological type, anatomical site, lesion size, and biological behavior. Some lesions may be discovered incidentally during routine dental examinations, whereas others may present with jaw swelling, delayed eruption or displacement of permanent teeth, cortical expansion, pain, or facial asymmetry. Because several odontogenic lesions may produce similar clinical findings, clinical examination alone may not provide sufficient diagnostic certainty. A comprehensive assessment combining clinical, radiographic, and histopathological findings is consequently required for accurate diagnosis [2].

Radiographic investigation is an important component of both diagnosis and treatment planning. Panoramic and intraoral radiographs can provide information regarding the location of the lesion, its relationship with developing or unerupted teeth, internal radiographic appearance, displacement of adjacent structures, and associated osseous changes. In selected cases, cone-beam computed tomography (CBCT) provides additional three-dimensional (3D) information regarding lesion extent, cortical expansion or perforation, internal architecture, and its relationship with adjacent anatomical structures. Such information can be particularly useful in determining the surgical accessibility and extent of tumor removal [3].

Histopathological examination remains a fundamental component of the diagnostic process for odontogenic tumors. Lesions with similar clinical or radiographic appearances may demonstrate substantially different microscopic characteristics and biological behavior. Histological evaluation allows identification of the cellular and architectural features necessary for definitive classification and assists in differentiating lesions with varying treatment requirements and recurrence potential. Correlation of histopathological findings with the clinical and radiographic presentation further improves diagnostic interpretation and supports appropriate treatment planning [4].

Surgical management of odontogenic tumors in children requires careful consideration of the balance between adequate tumor removal and preservation of developing craniofacial structures. Treatment selection is influenced by the histological

diagnosis, lesion size, anatomical location, extent, and biological aggressiveness. Conservative procedures, including enucleation and curettage, may be appropriate for selected lesions, whereas tumors exhibiting extensive involvement or more aggressive behavior may necessitate resection. In the pediatric population, preservation of developing permanent teeth, supporting bone, jaw growth, facial symmetry, and oral function should be considered whenever oncologically and surgically appropriate [5].

Postoperative evaluation is essential for determining treatment success and identifying potential complications or recurrence. Clinical follow-up may include assessment of swelling, pain, oral function, facial contour, and the subsequent eruption or development of permanent teeth. Radiographic follow-up can provide evidence of progressive bone healing, reduction or resolution of the original lesion, changes involving associated teeth, and the presence or absence of residual or recurrent disease. Regular surveillance is particularly important for lesions that possess a recognized tendency for local persistence or recurrence [6].

Published studies concerning odontogenic tumors in children have demonstrated variability in clinical presentation, tumor distribution, radiographic characteristics, treatment strategies, and postoperative outcomes. Differences in histopathological classification, anatomical location, surgical technique, and duration of follow-up may contribute to variation in reported treatment results. An integrated assessment of clinical findings, imaging characteristics, histopathological diagnosis, surgical intervention, and postoperative status can therefore provide a more comprehensive understanding of treatment outcomes in affected children [7].

Evaluation of these parameters may also assist in identifying factors associated with favorable postoperative recovery and successful preservation of the developing dentition. In particular, relating tumor characteristics to the selected surgical procedure and subsequent clinical and radiographic findings may provide useful information for individualized treatment planning. Such an approach is important in pediatric patients, in whom the consequences of surgical intervention extend beyond immediate tumor removal and may influence subsequent craniofacial growth and dental development [8], [9].

Therefore, the present study was undertaken to evaluate the clinical, radiographic, and histopathological characteristics of pediatric odontogenic tumors and to assess the outcomes following their surgical management. The study specifically assessed the relationship between tumor characteristics and the surgical treatment performed, postoperative clinical and radiographic changes, and the occurrence of recurrence during follow-up. By evaluating these parameters collectively, the study aimed to contribute clinically relevant evidence for optimizing surgical management while achieving effective lesion control and preserving the developing craniofacial and dental structures whenever possible.

MATERIALS & METHODS

Study Design and Study Population

The present study was conducted from July to December 2025 at a single tertiary care centre to evaluate the clinical, radiographic, histopathological, surgical, and postoperative characteristics of pediatric odontogenic tumors. A total of 30 pediatric patients with histopathologically confirmed odontogenic tumors were included in the study. The participants had a mean age of 12.7 ± 3.1 years and were categorized into three age groups: 6–9 years, 10–13 years, and 14–18 years. Both male and female patients were included, with males comprising 60.0% and females 40.0% of the study population.

Clinical Assessment

Clinical characteristics were evaluated for each patient, with particular attention to the presenting symptoms and signs associated with the tumor. The recorded clinical variables included painless swelling, pain or discomfort, facial asymmetry, delayed tooth eruption, tooth displacement or mobility, and incidental identification during radiographic examination. Painless swelling represented the predominant clinical presentation in the study population.

Radiographic Evaluation

Radiographic characteristics of the odontogenic tumors were assessed according to their internal appearance, lesion borders, and effects on adjacent anatomical structures. Lesions were categorized as unilocular radiolucent, multilocular radiolucent, mixed radiolucent-radiopaque, or predominantly radiopaque. The lesion margins were classified as well-defined or ill-defined. The presence or absence of cortical expansion and root displacement or resorption was also recorded.

Histopathological Assessment

Histopathological examination was used to establish the definitive diagnosis of the odontogenic tumors. The tumors were categorized according to their histopathological diagnosis, including unicystic ameloblastoma, adenomatoid odontogenic tumor, odontoma, ameloblastic fibroma, ameloblastic fibro-odontoma, solid/multicystic ameloblastoma, calcifying odontogenic tumor, and primordial odontogenic tumor. Unicystic ameloblastoma was the most frequently identified diagnosis in the study.

Surgical Management

The surgical procedure was selected according to the characteristics of the individual tumor. The recorded treatment modalities included enucleation with curettage, enucleation alone, marginal resection, partial/segmental resection, and marsupialization or decompression followed by enucleation. For analysis of recurrence, surgical procedures were additionally categorized into conservative and radical/segmental surgical approaches. Conservative procedures constituted the majority of interventions.

Postoperative Evaluation

Patients were evaluated for early postoperative healing and treatment response. Early postoperative outcomes included uncomplicated primary bone healing, delayed healing, postoperative infection, temporary paresthesia, and permanent neurosensory deficit. Overall treatment response was assessed according to complete clinical and radiographic resolution, residual radiographic defect requiring continued observation, recurrence, requirement for secondary surgery, and mortality.

Assessment of Tumor Recurrence

Tumor recurrence was recorded during the available follow-up period. Recurrence was analyzed in relation to the type of surgical intervention, radiographic characteristics, and histopathological diagnosis. Particular attention was given to cortical expansion and root displacement or resorption because these radiographic variables demonstrated statistically significant associations with recurrence in the study population.

Statistical Analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Appropriate descriptive and inferential statistical methods were applied according to the type and distribution of the data. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage [n (%)]. Associations between categorical variables, including surgical approach, radiographic features, histopathological diagnosis, and tumor recurrence, were assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant, with a 95% confidence level. Given the small sample size and low number of recurrence events, Fisher's exact test was preferred wherever expected cell frequencies were small.

RESULTS

Table 1 & Figure 1 summarize the demographic characteristics of the study population. The study comprised 30 participants with a mean age of 12.7 ± 3.1 years. The largest proportion, 14 participants (46.7%), belonged to the 10–13-year age group, followed by 10 (33.3%) aged 14–18 years and 6 (20.0%) aged 6–9 years. Males accounted for 18 participants (60.0%), whereas females comprised 12 (40.0%), giving a male-to-female ratio of 1.50:1. Overall, adolescents aged 10–13 years and male participants constituted the predominant groups.

Table 1: Demographic characteristics of the study population

Parameter	Value
Age (years), mean ± SD	12.7 ± 3.1
Age 6–9 years	6 (20.0%)
Age 10–13 years	14 (46.7%)

Age 14–18 years	10 (33.3%)
Male	18 (60.0%)
Female	12 (40.0%)
Male: Female ratio	1.50:1

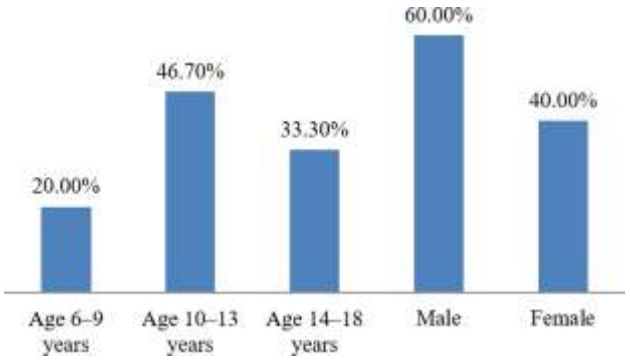

Figure 1: Age and sex distribution of the study population

Table 2 & Figure 2 illustrate the anatomical distribution of the tumors. The mandible was the predominant site, accounting for 23 cases (76.7%), while the maxilla was involved in 7 cases (23.3%). Within the mandible, tumors were more frequently located in the posterior region (16 cases, 53.3%) than in the anterior region (7 cases, 23.3%). In the maxilla, 5 cases (16.7%) occurred posteriorly and 2 cases (6.7%) anteriorly. Overall, the posterior mandible was the most commonly affected anatomical site.

Table 2: Anatomical distribution of tumors

Site	n (%)
Mandible	23 (76.7%)
Maxilla	7 (23.3%)
Posterior mandible	16 (53.3%)
Anterior mandible	7 (23.3%)
Posterior maxilla	5 (16.7%)
Anterior maxilla	2 (6.7%)

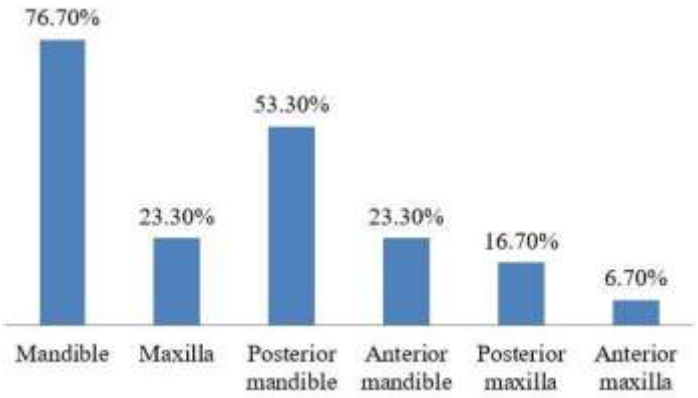

Figure 2: Anatomical distribution of pediatric odontogenic tumors according to jaw and regional involvement

Table 3 & Figure 3 summarize the clinical presentations of pediatric odontogenic tumors. Painless swelling was the most frequently observed feature, occurring in 20 cases (66.7%). This was followed by facial asymmetry in 8 cases (26.7%), tooth displacement or mobility in 7 cases (23.3%), and pain or discomfort in 6 cases (20.0%). Delayed tooth eruption was reported in 5 cases (16.7%), while 4 cases (13.3%) were identified incidentally during radiographic evaluation. Thus, painless swelling represented the predominant clinical presentation, whereas incidental radiographic detection was least common.

Table 3: Clinical presentation of pediatric odontogenic tumors

Clinical finding	**n (%)**
Painless swelling	20 (66.7%)
Pain/discomfort	6 (20.0%)
Delayed tooth eruption	5 (16.7%)
Facial asymmetry	8 (26.7%)
Tooth displacement/mobility	7 (23.3%)
Incidental radiographic finding	4 (13.3%)

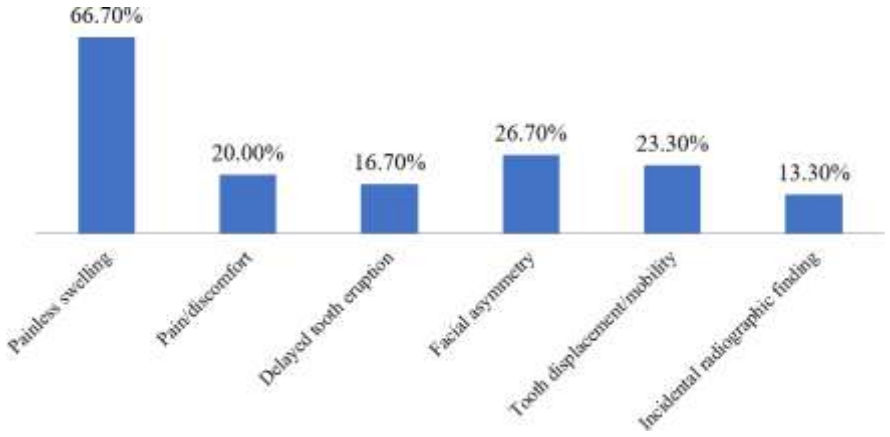

Figure 3: Distribution of clinical presentations among pediatric odontogenic tumor cases

Table 4 & Figure 4 summarize the radiographic characteristics of the tumors. Unilocular radiolucency was the predominant internal pattern, identified in 18 cases (60.0%), followed by multilocular radiolucency in 8 cases (26.7%). Mixed radiolucent-radiopaque lesions were observed in 3 cases (10.0%), while predominantly radiopaque lesions occurred in 1 case (3.3%).

Most tumors exhibited well-defined borders (25 cases, 83.3%), whereas ill-defined margins were observed in 5 cases (16.7%). Cortical expansion was present in 19 cases (63.3%), while root displacement and/or resorption was noted in 11 cases (36.7%). Overall, the tumors predominantly appeared as well-defined unilocular radiolucencies, with cortical expansion occurring more frequently than root displacement or resorption.

Table 4: Radiographic characteristics

	Radiographic characteristic	**n (%)**
Based on internal radiographic appearance	Unilocular radiolucency	18 (60.0%)
	Multilocular radiolucency	8 (26.7%)
	Mixed radiolucent-radiopaque lesion	3 (10.0%)

	Predominantly radiopaque lesion	1 (3.3%)
Based on Borders	Well-defined border	25 (83.3%)
	Ill -defined border	04 (16.7%)
Based on Cortical Expansion	Cortical expansion	19 (63.3%)
	Root displacement/resorption	11 (36.7%)

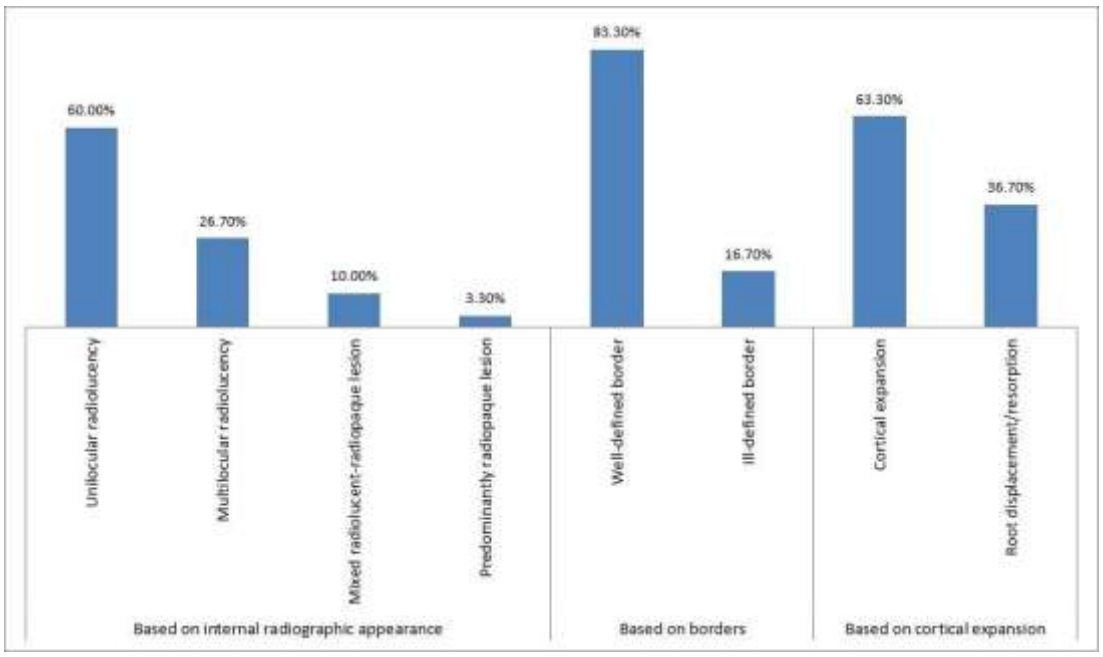

Figure 4: Radiographic characteristics of pediatric odontogenic tumors based on internal appearance, lesion borders, and effects on adjacent structures

Table 5 & Figure 5 summarize the histopathological diagnoses of the odontogenic tumors included in the study. Unicystic ameloblastoma was the most commonly identified tumor, comprising 8 cases (26.7%). Adenomatoid odontogenic tumor was the second most frequent diagnosis, accounting for 6 cases (20.0%), followed by odontoma in 5 cases (16.7%). Ameloblastic fibroma was observed in 4 cases (13.3%), whereas ameloblastic fibro-odontoma was diagnosed in 3 cases (10.0%). Solid/multicystic ameloblastoma was identified in 2 cases (6.7%). Calcifying odontogenic tumor and primordial odontogenic tumor were the least frequently encountered lesions, with 1 case each (3.3%). Overall, the histopathological profile indicated a higher prevalence of unicystic ameloblastoma and adenomatoid odontogenic tumor, which collectively represented 46.7% of the study population.

Table 5: Histopathological Diagnosis

Histopathological diagnosis	**n (%)**
Unicystic ameloblastoma	8 (26.7%)
Adenomatoid odontogenic tumor	6 (20.0%)
Odontoma	5 (16.7%)
Ameloblastic fibroma	4 (13.3%)
Ameloblastic fibro-odontoma	3 (10.0%)

Solid/multicystic ameloblastoma	2 (6.7%)
Calcifying odontogenic tumor	1 (3.3%)
Primordial odontogenic tumor	1 (3.3%)

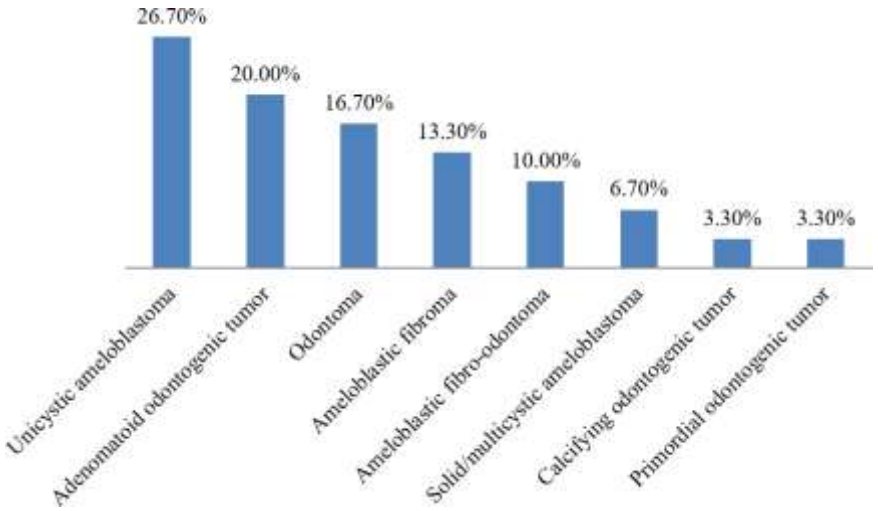

Figure 5: Distribution of Histopathological Diagnoses Among Pediatric Odontogenic Tumors

The surgical procedures used for the management of pediatric odontogenic tumors are summarized in Table 6 and Figure 6. Enucleation with curettage was the most frequently performed intervention, accounting for 13 cases (43.3%). Enucleation alone was performed in 7 cases (23.3%), followed by marginal resection in 5 cases (16.7%). Partial or segmental resection was required in 3 cases (10.0%), whereas marsupialization/decompression followed by enucleation was undertaken in 2 cases (6.7%).

Overall, the findings indicate that conservative surgical techniques were preferred in most pediatric cases, with enucleation-based procedures comprising the largest proportion, while more extensive resection was reserved for a smaller subset of tumors.

Table 6: Surgical procedures performed

Surgical procedure	**n (%)**
Enucleation + curettage	13 (43.3%)
Enucleation alone	7 (23.3%)
Marginal resection	5 (16.7%)
Partial/segmental resection	3 (10.0%)
Marsupialization/decompression followed by enucleation	2 (6.7%)

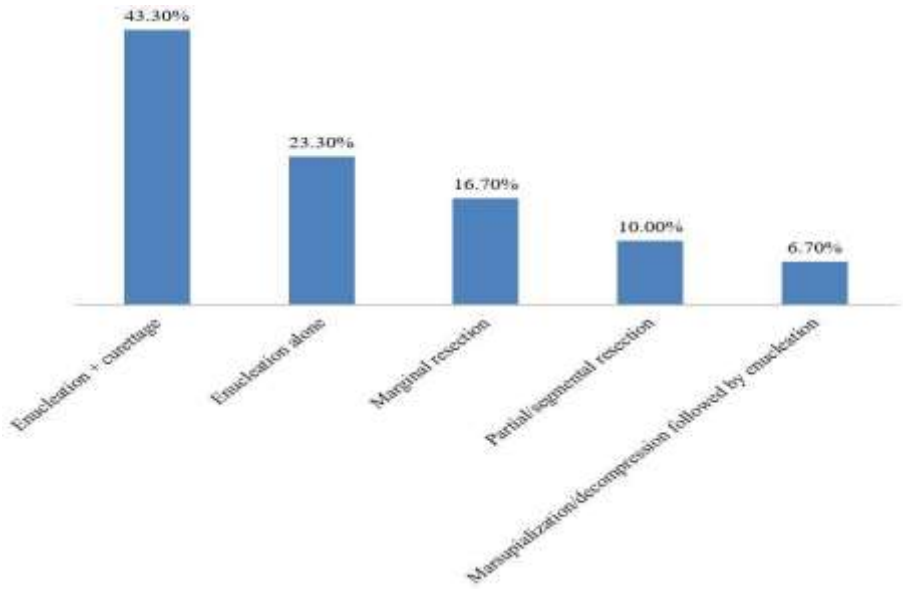

Figure 6: Distribution of surgical procedures used for the management of pediatric odontogenic tumors

Table 7 & Figure 7 summarize the early postoperative outcomes observed after surgical treatment. Uncomplicated primary bone healing was achieved in 25 patients (83.3%), making it the predominant postoperative outcome. Delayed healing was noted in 3 patients (10.0%), whereas postoperative infection occurred in 2 patients (6.7%). Temporary paresthesia was reported in 1 patient (3.3%); however, no patient developed a permanent neurosensory deficit. Overall, the early postoperative period was characterized by satisfactory recovery, with most patients showing uncomplicated healing and an absence of permanent sensory complications.

Table 7: Early postoperative outcomes

Outcome	**n (%)**
Primary bone healing without complication	25 (83.3%)
Delayed healing	3 (10.0%)
Postoperative infection	2 (6.7%)
Temporary paresthesia	1 (3.3%)
Permanent neurosensory deficit	0 (0.0%)

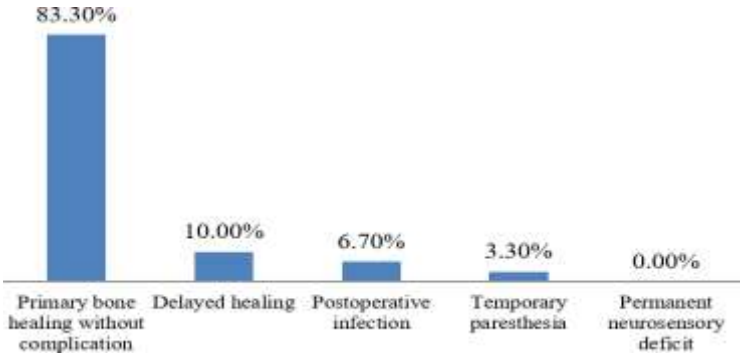

Figure 7: Distribution of early postoperative outcomes following surgical management of pediatric odontogenic tumors

Table 8 & Figure 8 summarize the occurrence of tumor recurrence in relation to the surgical treatment modality. During the follow-up period, recurrence was identified in 1 patient (3.3%) out of 30 cases, while the remaining 29 patients (96.7%) remained recurrence-free. Among patients treated with conservative surgical procedures, recurrence was documented in 1 case (4.5%), whereas 21 cases (95.5%) showed no evidence of recurrence. In the radical/segmental surgery group, none of the 8 patients (0.0%) experienced recurrence, with all 8 cases (100.0%) remaining disease-free during follow-up. Although recurrence was slightly more frequent after conservative treatment, the difference between the two surgical approaches was not statistically significant ($\chi^2 = 0.376$, $p = 0.540$). Therefore, the present findings did not demonstrate a significant relationship between the surgical approach and postoperative tumor recurrence.

Table 8: Recurrence according to surgical approach

Surgical approach	n	Recurrence n (%)	No recurrence n (%)	χ^2 value	p-value
Conservative surgery	22	1 (4.5%)	21 (95.5%)	0.376	0.540
Radical/segmental surgery	8	0 (0.0%)	8 (100.0%)		
Total	**30**	**1 (3.3%)**	**29 (96.7%)**		

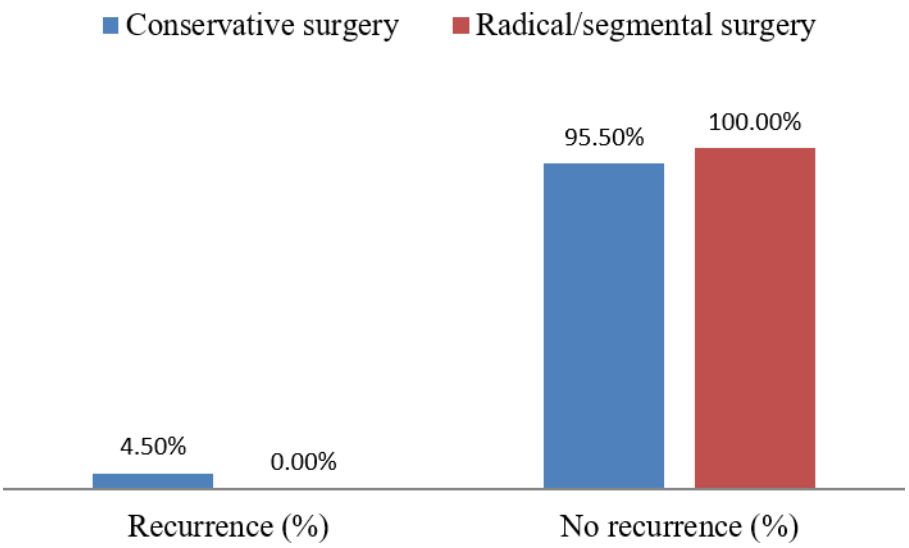

Figure 8: Tumor recurrence according to surgical treatment approach in pediatric odontogenic tumors

Table 9 & Figure 9 demonstrate the relationship between selected radiographic characteristics and tumor recurrence. Among the 19 patients exhibiting cortical expansion, recurrence was recorded in 1 case (5.3%), while 18 cases (94.7%) remained recurrence-free. In contrast, none of the 11 patients without cortical expansion experienced recurrence, with all 11 cases (100.0%) showing no evidence of recurrence. The association between cortical expansion and recurrence was reported as statistically significant ($p = 0.001$).

A similar pattern was observed for root resorption or displacement. Recurrence occurred in 1 of 11 cases (9.1%) demonstrating root resorption/displacement, whereas 10 cases (90.9%) did not develop recurrence. Among the 19 cases without root resorption or displacement, no recurrence was observed, and all 19 cases (100.0%) remained recurrence-free. This association was also reported to be statistically significant ($p = 0.036$).

Overall, the findings indicate that cortical expansion and root resorption/displacement were associated with an increased occurrence of tumor recurrence in the study population.

Table 9: Association of radiographic features with recurrence

	Radiographic feature	Total	Recurrence	No recurrence	p-value
Based on Cortical expansion	Cortical expansion present	19	1 (5.3%)	18 (94.7%)	0.001*
	Cortical expansion absent	11	0 (0.0%)	11 (100.0%)	
Based on Root resorption	Root resorption/displacement present	11	1 (9.1%)	10 (90.9%)	0.036*
	Root resorption/displacement absent	19	0 (0.0%)	19 (100.0%)	

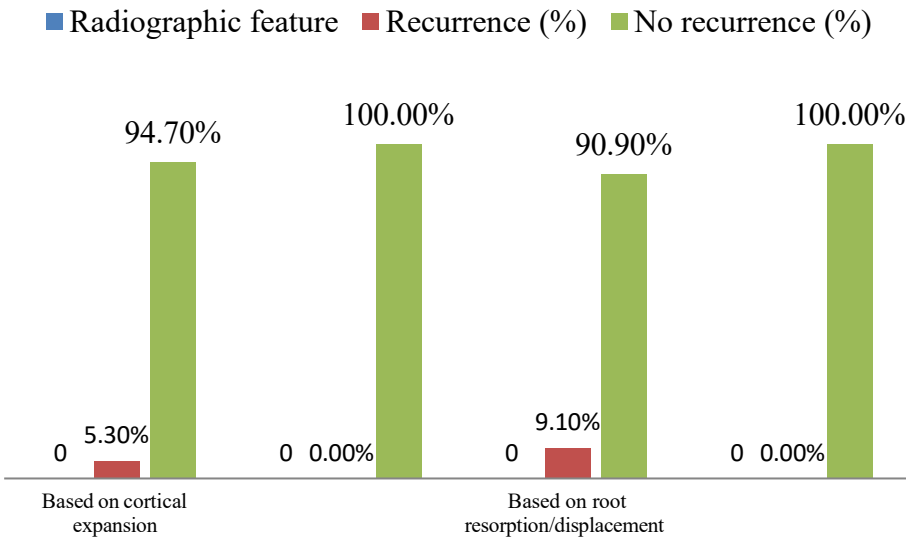

Figure 9: Association of Radiographic Features With Tumor Recurrence in Pediatric Odontogenic Tumors

Table 10 & Figure 10 present the distribution of tumor recurrence according to histopathological diagnosis. The only recurrence was identified among patients with unicystic ameloblastoma, where 1 of 8 cases (12.5%) developed recurrence during the follow-up period. No recurrent tumors were observed among patients diagnosed with adenomatoid odontogenic tumor (0/6, 0.0%), odontoma (0/5, 0.0%), ameloblastic fibroma (0/4, 0.0%), or ameloblastic fibro-odontoma (0/3, 0.0%). Similarly, none of the patients categorized under other odontogenic tumors (0/4, 0.0%) experienced recurrence. Overall, recurrence occurred in 1 of the 30 patients (3.3%), and this event was confined to a case of unicystic ameloblastoma.

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Table 10: Histopathological diagnosis, surgical management, and recurrence

Diagnosis	n	Recurrence n (%)
Unicystic ameloblastoma	8	1 (12.5%)
Adenomatoid odontogenic tumor	6	0 (0.0%)

Odontoma	5	0 (0.0%)
Ameloblastic fibroma	4	0 (0.0%)
Ameloblastic fibro-odontoma	3	0 (0.0%)
Other tumors	4	0 (0.0%)
Total	**30**	**1 (3.3%)**

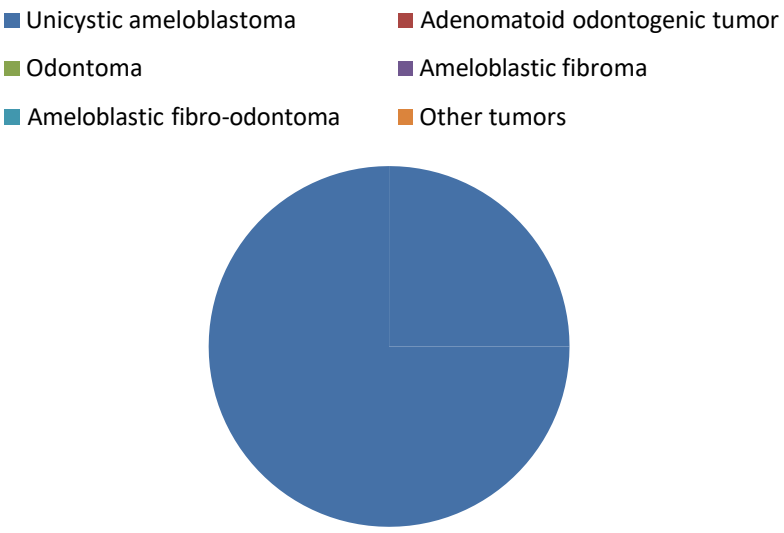

Figure 10: Distribution of tumor recurrence according to histopathological diagnosis in pediatric odontogenic tumors

Table 11 presents the overall treatment outcomes in the study population. The treatment results were generally favorable, with complete clinical and radiographic resolution achieved in 27 patients (90.0%), making it the most common treatment outcome. Residual radiographic abnormalities requiring further monitoring were observed in 2 patients (6.7%). Tumor recurrence was documented in 1 patient (3.3%), and secondary surgical intervention was required in 1 patient (3.3%). No deaths were recorded during the follow-up period. Overall, the findings demonstrate a high rate of successful treatment, with most patients achieving complete clinical and radiographic resolution and only a small proportion experiencing recurrence or requiring additional surgery.

Table 11: Overall treatment outcomes

Outcome	**n (%)**
Complete clinical/radiographic resolution	27 (90.0%)
Residual radiographic defect requiring continued observation	2 (6.7%)
Recurrence	1 (3.3%)
Need for secondary surgery	1 (3.3%)
Mortality	0 (0.0%)

DISCUSSION

Pediatric odontogenic tumors represent an important diagnostic and therapeutic challenge because their clinical behavior, radiographic appearance, and histopathological characteristics may vary considerably between individual lesions. In the present study, emphasis was placed on the integrated assessment of clinical presentation, radiographic findings, histopathological diagnosis, surgical management, and postoperative outcomes. Such a multidimensional approach is important in pediatric patients because treatment must achieve adequate lesion control while minimizing damage to developing teeth, jaw structures, and facial growth.

The importance of individualized surgical planning has been emphasized by Huang et al. (2007) [10], who evaluated the surgical management of ameloblastoma in children and highlighted the difficulty of balancing adequate tumor removal with preservation of developing craniofacial structures. Their findings support the concept that treatment selection should be based on the biological behavior, anatomical extent, and clinical characteristics of the lesion rather than applying a uniform surgical approach to all pediatric odontogenic tumors. This principle is particularly relevant to the present study, in which surgical treatment was considered in relation to the individual clinical and radiographic characteristics of the tumors.

The choice between conservative and more extensive surgical treatment is also influenced by the potential for recurrence. Saalim et al. (2019) [11], in their systematic review of odontogenic myxoma, reported differences in recurrence according to the treatment modality and demonstrated the importance of considering recurrence risk when selecting between conservative procedures and surgical resection. Their findings reinforce the need for prolonged postoperative surveillance, particularly in lesions with locally infiltrative or aggressive characteristics. In the present study, postoperative follow-up incorporating clinical and radiographic evaluation was therefore important for identifying persistent or recurrent disease and for assessing the effectiveness of the selected surgical procedure.

The biological behavior of odontogenic tumors cannot be interpreted solely on the basis of their clinical appearance. Martínez-Mata et al. (2008) [12] demonstrated considerable clinicopathological variation in odontogenic myxoma and emphasized the value of integrating morphological, immunohistochemical, and ultrastructural findings in the characterization of these lesions. These observations support the importance of histopathological confirmation in the present study. Clinical and radiographic findings may suggest a particular lesion, but microscopic examination remains essential for establishing the final diagnosis and guiding subsequent management.

The molecular characteristics of odontogenic tumors may also contribute to their biological behavior. Gomes et al. (2011) [13] reviewed the molecular features of odontogenic myxoma and discussed the biological mechanisms potentially involved in its development and progression. Although molecular investigations were not the primary focus of the present study, the findings from the literature indicate that differences in tumor biology may partly explain variations in growth pattern, local aggressiveness, and recurrence. Consequently, histopathological diagnosis and careful postoperative monitoring remain important components of the management of pediatric odontogenic tumors.

The clinical and pathological heterogeneity of odontogenic myxoma has also been demonstrated by Li et al. (2006) [14], who reported clinicopathological findings in a series of cases. Their observations emphasize that odontogenic myxoma may demonstrate variable clinical and microscopic characteristics and that accurate diagnosis requires correlation of the clinical presentation with pathological findings. This is particularly important in pediatric patients, in whom an expansile jaw lesion may have several possible odontogenic and non-odontogenic differential diagnoses. In the present study, the combined evaluation of clinical, radiographic, and histopathological findings was therefore considered essential for establishing an appropriate diagnosis before definitive treatment.

Radiographic assessment is especially valuable when odontogenic lesions are associated with unerupted or impacted teeth. De Campos et al. (2025) [15] evaluated the radiographic features of radiolucent odontogenic lesions associated with impacted teeth in a large cross-sectional series of 454 cases. Their findings demonstrate the diagnostic value of radiographic characteristics and the importance of assessing the relationship between radiolucent lesions and impacted teeth. This has particular relevance in the pediatric population because developing permanent teeth are frequently involved in odontogenic lesions. Detailed radiographic assessment can therefore assist in determining lesion extent, tooth involvement, and the most appropriate surgical strategy while helping clinicians anticipate possible effects on the developing dentition.

Taken together, the findings of the present study and the available literature indicate that successful management of pediatric odontogenic tumors requires a multidisciplinary diagnostic approach. Clinical findings provide information regarding symptoms, swelling, tooth eruption disturbances, and functional effects, while radiographic examination defines lesion location, extent, internal characteristics, and relationships with developing teeth and adjacent structures. Histopathological evaluation then establishes the definitive diagnosis and provides information relevant to biological behavior and treatment planning.

The literature also supports the importance of balancing tumor eradication with preservation of normal pediatric structures. Huang et al. (2007) [10] emphasized the challenges associated with surgical treatment in children, whereas Saalim et al. (2019) [11] demonstrated the relevance of treatment modality to recurrence risk. These observations collectively suggest that conservative surgery may be advantageous when adequate lesion control can be achieved without compromising treatment success, while more extensive procedures may be justified for lesions demonstrating aggressive behavior, extensive involvement, or a greater risk of recurrence.

Another important consideration is long-term follow-up. The potential for recurrence varies according to tumor type, biological behavior, surgical technique, and completeness of removal. The evidence provided by Saalim et al. (2019) [11] particularly supports continued clinical and radiographic surveillance following treatment of lesions with recurrence potential. In pediatric patients, follow-up has an additional purpose because successful treatment should ideally be accompanied by preservation or restoration of normal tooth eruption, bone development, facial symmetry, and oral function.

Overall, the present study supports an integrated approach to pediatric odontogenic tumors in which clinical examination, radiographic assessment, histopathological confirmation, individualized surgical treatment, and systematic postoperative follow-up are considered complementary components of patient management. The available evidence indicates that no single diagnostic or therapeutic parameter is sufficient for optimal decision-making. Instead, treatment should be tailored according to the specific tumor characteristics, anatomical extent, biological behavior, and developmental status of the child. This approach may facilitate effective tumor control while reducing unnecessary morbidity and preserving the developing craniofacial and dental structures whenever clinically feasible.

LIMITATIONS

The present study has several limitations that should be considered when interpreting its findings. First, the study was conducted at a single tertiary care centre, which may limit the generalizability of the results to other institutions and pediatric populations with different demographic and clinical characteristics. Second, the relatively small sample size of 30 patients limits the statistical power of the study, particularly for subgroup comparisons and analyses of individual tumor types.

The study included a heterogeneous group of pediatric odontogenic tumors, several of which were represented by only a small number of cases. Therefore, comparisons between specific histopathological subtypes should be interpreted cautiously. In addition, the relatively low number of recurrence events may have limited the ability to identify independent predictors of recurrence or establish robust associations between surgical treatment and long-term outcomes.

The follow-up period was based on the available clinical records and may not have been sufficiently long or uniform to detect all late recurrences, particularly for tumors known to have a prolonged recurrence interval. Variability in the duration and completeness of follow-up could therefore influence the observed recurrence rate. Furthermore, the retrospective or observational nature of the clinical data may have introduced information and selection biases.

Although important clinical, radiographic, histopathological, and surgical variables were evaluated, potentially relevant factors such as tumor molecular characteristics, detailed surgical margins, genetic alterations, and standardized quality-of-life outcomes were not assessed. The study also did not incorporate advanced predictive statistical models because of the limited sample size. Larger, multicentre studies with standardized long-term follow-up and incorporation of molecular and prognostic markers are required to validate the present findings.

CONCLUSION

The study demonstrated considerable variation in the clinical, radiographic, histopathological, and surgical characteristics of pediatric odontogenic tumors. Painless swelling was the most common presentation, and unicystic ameloblastoma was the predominant histopathological diagnosis. Conservative surgery was the most frequently used treatment approach. Recurrence

showed significant associations with cortical expansion and root displacement or resorption, highlighting the importance of thorough radiographic evaluation. Individualized treatment and long-term follow-up are essential for optimal outcomes. Larger multicentre studies with extended follow-up are recommended to further identify prognostic factors and improve treatment strategies.

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