International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

A Novel Parameter (CK 19) in Odontogenic Cyst & Tumor: Clinical, Radiographic & IHC Study

Dr. Nikita Gayakwad[1], Dr. Priyanshi Jayesh Parikh[2], Dr. Shilpa Parikh[3], Dr. Jigna Shah[4]

[1]Post Graduate Student, Department of Oral Medicine and Radiology, Government Dental College and Hospital, Civil hospital, Ahmedabad- 380016, Gujarat, India
Email ID: gayakwadnikita97[at]gmail.com

[2]Post Graduate Student, Department of Oral Pathology and Microbiology, College of Dental Sciences and Research Centre
Email ID: priyanshiparikh2021[at]gmail.com

[3]Professor and PG Guide, Department of Oral Medicine and Radiology, Government Dental College and Hospital, Civil Hospital, Ahmedabad- 380016, Gujarat, India
Email ID: drshilpaparikh[at]hotmail.com

[4]Professor and HOD, Department of Oral Medicine and Radiology, Government Dental College and Hospital, Civil Hospital, Ahmedabad-380016, Gujarat, India
Email ID: jignasathya[at]gmail.com

Abstract: ***Odontogenic lesions encompass a variety of cysts and tumors with distinct clinical, radiographic, and histological characteristics. Accurate diagnosis often relies on histopathological analysis, though overlapping features between different lesions can complicate identification. Immunohistochemistry (IHC), particularly CK 19 expression, can aid in diagnosis by distinguishing these lesions and guiding treatment strategies. Aim: To assess clinical, radiographic, and histologic features of odontogenic cysts and tumors, and analyze CK19 expression patterns. Method: A total of 62 patients diagnosed with various odontogenic lesions at the Oral Medicine and Radiology department between 2022 and 2024 were studied. Clinical examinations, radiographic assessments, and histopathological evaluations were conducted. CK 19 expression was analyzed using immunohistochemistry on paraffin-embedded tissue samples, including radicular cysts, dentigerous cysts, odontogenic keratocysts (OKC), orthokeratinized keratocysts, and ameloblastomas. Results: CK 19 expression varied significantly across lesions (P = 0.01). Radicular cysts, dentigerous cysts, and ameloblastomas showed notable positivity rates (64.28%, 80%, and 77.92%, respectively). OKCs demonstrated 60.71% positivity, while orthokeratinized keratocysts were negative for CK 19 expression. Conclusion: The findings indicate that CK 19 serves as a valuable marker for identifying odontogenic epithelial components, helping clarify the biological behavior and aggressiveness of these lesions. Further exploration of IHC's role could refine diagnostic processes and optimize treatment plans for odontogenic lesions.***

Keywords: Odontogenic Tumors, Odontogenic Cysts, Immunohistochemistry (IHC), Cytokeratin-19 (CK19)

1.Introduction

The pathology associated with the odontogenic tissues covers a wide range of lesions (odontogenic cysts and tumors) with varying aetiologies. The diagnosis of these lesions involves a comprehensive clinical and radiographic assessment, which can be challenging due to the rarity of these conditions and the similarities in clinical and radiological presentations among certain odontogenic lesions, which often leads to differential diagnosis that can only be clarified by histologic findings. Histopathology has remained, to this day, the gold standard. However, in some cases variable appearance of the same lesion and overlapping histology among different lesions may lead to further difficulties. It is at such times that immunohistochemistry (IHC) steps in as a valuable adjunct to histopathology, aiding in the accurate identification of the pathology for an ideal treatment plan.[1,2]

Immunohistochemistry (IHC) is a method to localize specific antigens in formalin-fixed, paraffin-embedded (FFPE) tissues based on antigen–antibody interaction (Taylor and Burns, 1974).[2,3] The cytoskeleton of cells is formed by three main structural units and associated proteins: microfilaments, microtubules and intermediate filaments. Cytokeratin belonging to intermediate family protein. The expression pattern of intermediate filaments has been investigated in normal and neoplastic human cells including oral epithelial cells, odontogenic epithelia, tumors and cysts. These investigators hypothesize that intermediate filaments expression patterns are characteristic for each kind of cells. Cytokeratin 19 (CK 19) is the smallest known acidic type of cytokeratin, having molecular mass of 40 kD (KiloDalton). It is expressed in developing tooth germs, and also in neoplastic epithelial cells of some odontogenic tumors. It is also detected in cell rests of Malassez, cell rests of Serres, and lining of odontogenic cysts. The overexpression of CK 19 is useful for identification of odontogenic epithelial components, in evaluating the various types of epithelial odontogenic cysts and tumor and their potential for proliferation.[4-6] So, IHC seems to be useful for evaluation of tumors by molecular biomarkers. It also provides valuable information about the nature of the lesions in terms of their biological behavior, aggressiveness, and tendency for recurrence, thereby also helping to determine the prognosis of the lesion.

The current study highlights diverse clinical and radiographic features observed in various odontogenic cysts and tumors, as well as their patterns of expression of CK 19—an IHC marker—in their epithelium.

2.Material and Method

A total of 62 patients with a diagnosis of odontogenic cysts and tumors, who visited the oral medicine and radiology department between 2022 and 2024, were included. The study protocol was approved by the Institutional Ethical Committee of Government Dental College & Hospital, Ahmedabad. All ethical guidelines were followed, and written informed consent was obtained from the patients who were selected for the study.

Inclusion criteria comprised patients with symptoms such as pain, swelling, discharge (pus, blood, or serous fluid), facial asymmetry, and missing or mobile teeth, irrespective of age and gender. Clinically, radiographically, and histologically confirmed cases of non-syndromic odontogenic cysts and tumors, willing to participate, were selected. **Exclusion criteria** included uncooperative patients, those unwilling to participate, those with non-odontogenic lesions, and cases not histopathologically confirmed. A comprehensive clinical examination and radiographic characteristics were conducted for all patients with odontogenic cysts and tumors and recorded in standard proforma.

After selecting patients, a detailed case history was taken, including demographic data and symptoms like pain, swelling, facial asymmetry, missing or mobile teeth, and fluid discharge. Clinical evaluation recorded the site, eggshell cracking, and the condition of teeth (missing, carious, impacted, fractured, displaced, tilted, or mobile). A radiographic examination assessed lesion radiodensity (radiolucent, radiopaque, or mixed), site, internal structure (unilocular or multilocular), borders, root resorption, tooth displacement, and specific trabecular patterns (e.g., honeycomb, soap bubble). Based on the findings, a provisional and comprehensive differential diagnosis was made. Patients were referred to the oral surgery department for lesion excision, and tissue samples were sent for histological evaluation to confirm the final diagnosis. Paraffin-embedded tissue samples from confirmed cases of odontogenic cysts and tumors were then sent to the laboratory for CK-19 expression assessment using immunohistochemistry.

Immunohistochemistry procedure: 3 µm sections were cut from paraffin-embedded blocks using a semiautomatic microtome and placed on poly-L-lysine-coated slides. Slides were heated at 70-80°C for 2 hours, then at 50°C overnight. Paraffin was removed using three 5-minute xylene washes (0.5 µg/ml) and two 5-minute washes in 70% isopropyl alcohol, followed by rehydration in water. Antigen retrieval was done in 1X citrate buffer using an autoclave at 15 lbs pressure for 15 minutes. Slides were washed in 0.1M PBS (pH 7.2) for 5 minutes. Peroxidase and protein blocking were done with 3% hydrogen peroxide and protein block reagent for 10 minutes each. Primary antibodies (concentrated rabbit polyclonal anticalretinin antibody, Biogenex) were applied overnight at room temperature. Anti-human CK19 antibody was incubated for 2 hours at room temperature. The secondary antibody (an enhancer and streptavidin solution from the polymer kit) was applied for 20 minutes. A drop of 1% DAB (3'-diaminobenzidine tetrahydrochloride—A substrate chromogen) solution was added, and PBS washes were performed after each step. Sections were counterstained with hematoxylin and mounted with DPX (a mixture of distyrene, a plasticizer, and xylene). The 62 stained slides were evaluated under bright field microscopy at 100x and 200x magnification. The extent of cytoplasmic staining, indicating CK19 presence (Kamath KP et al.), was graded as follows:

- **Grade I ('+')**: Single layer of the lining epithelium stained.
- **Grade II ('++')**: More than one layer stained, but not the entire thickness.
- **Grade III ('+++')**: Entire thickness of the lining epithelium stained.

Tissue sections without CK19 expression were considered negative.

3.Results

In this study, 62 patients with histopathologically confirmed odontogenic lesions underwent clinical, radiographic, and immunohistochemical evaluation for CK19 expression. The odontogenic cysts included were radicular cysts (RCs), dentigerous cysts (DCs), odontogenic keratocysts (OKCs), and orthokeratinized odontogenic keratocysts (OOCs). The odontogenic tumor evaluated was ameloblastoma.

RC, OKC, OOC, and ameloblastoma were most common in the 21-40 age group, while DC was equally common in the 0-20 and 21-40 groups. Males predominated in RC and ameloblastoma, females in DC and OKC, with OOC equally affecting both genders. (Table 1)

For RCs, 78.57% presented with swelling, primarily in the maxillary anterior (57.14%). Radiographically, all were radiolucent and unilocular, with root resorption noted in 14.28%. Histologically, RCs displayed thin stratified squamous epithelium with Rushton bodies in 21.42% and fibrous connective tissue with inflammation in all cases; necrosis was observed in 64.28% (**Figure 1** (**A & B**)). All DC cases showed swelling, with 40% in both the maxillary anterior and mandibular posterior. Radiographically, they were radiolucent, unilocular, and associated with unerupted/impacted teeth. Histologically, all DCs had thin stratified squamous epithelium; connective tissue was loose in 60%, fibrous in 80%, and collagenous in 20%. Inflammation was present in 40%, and cholesterol clefts were noted in 20% (**Figure 2** (**A & B**)). OKCs also consistently presented with swelling, mainly in the mandibular posterior (82.14%). Radiographically, 53.57% were radiolucent, 46.42% mixed; 85.71% were multilocular with scalloped borders, and 17.85% exhibited root resorption. Histologically, 53.57% of OKCs had thin epithelium, and 46.42% had thick epithelium, all showing stratified squamous epithelium with parakeratin and basal cell palisading. Fibrous tissue was observed in 71.42%, collagenous in 28.57%, and inflammation in 78.57%. Additionally, 57.14% had a corrugated appearance and 78.57% displayed an onion-skin pattern in luminal tissue (**Figure 3** (**A & B**)). Both OOC cases (100%) presented with swelling, equally split between the mandibular anterior and

posterior. Radiographically, they were radiolucent, multilocular with scalloped borders, and associated with unerupted teeth. Histologically, they had thin stratified squamous epithelium with orthokeratin and collagenous connective tissue, showing an onion-skin appearance. All ameloblastoma cases presented with swelling, mostly in the mandibular posterior (76.92%), and eggshell cracking was evident in 76.92%. Radiographically, all were mixed, showing scalloped, multilocular borders; 53.84% had a honeycomb appearance, and 15.38% had a soap-bubble appearance, with root resorption present in all cases. Histologically, 84.61% had thin and 15.38% had thick epithelium. Cuboidal cells were seen in 23.07%, while 76.92% showed tall-columnar cells. Fibrous connective tissue was observed in 76.92%, collagenous in 23.07%, and daughter cysts in 46.15% (**Figure 4** (**A & B**)). (Table 1)

The P value for CK 19 expression in odontogenic cysts and tumors was not statistically significant (P = 0.27) (Table 2). However, a statistically significant difference was found in the intergroup comparison of CK 19 expression patterns in odontogenic cysts and tumors (P = 0.01) (Table 3). Comparisons between RC and DC, RC and ameloblastoma, DC and OKC, and DC and ameloblastoma showed no significant differences. In contrast, significant differences were observed between RC and OKC (P = 0.03) and between OKC and ameloblastoma (P = 0.01) (Table 3).

4.Discussion

Diagnosing odontogenic cysts and tumors requires a comprehensive assessment of clinical and radiographic features, often leading to differential diagnosis that only clarified by histologic findings. In many cases, a few key histologic observations are required. Few studies have reported the use of CK 19 in odontogenic cysts and tumors. This study evaluated CK 19 expression in RCs, DCs, OKCs, OOCs, and ameloblastomas, along with its expression patterns.

In the present study, most RCs (78.57%) presented as swellings, predominantly in the maxillary anterior region (57.14%), and were frequently associated with fractured teeth (57.14%). All cases were radiolucent and unilocular, with root resorption evident in 14.28%. Histologically, all cases showed thin stratified squamous epithelium, with inflammation present in all cases and necrosis observed in 64.28%. Additionally, 21.42% exhibited Rushton bodies, while 35.71% had hyaline bodies and 14.28% displayed cholesterol clefts. These findings align with studies by Anchal Bhat et al.[7], Jeng-Huey Chen et al.[8], Luis Villasis-Sarmiento et al.[9], and Jeevanand Deshmukh et al.[10] RCs typically result from pulpal necrosis spreading to the peri-radicular tissue, prompting the proliferation of epithelial rests of Malassez into a cystic lesion, often triggered by trauma, dental caries, and chronic irritation. The maxillary anterior region's high incidence is likely due to trauma as a primary etiological factor, alongside carious teeth.[8-10] (Table 1)

In the present study, DCs had an equal distribution in the age groups of 0-20 and 21-40 years, with females being the most commonly affected. Clinically, it presented with swelling (100%), equally distributed in the maxillary anterior and mandibular posterior regions (40%), with 80% associated with unerupted or impacted teeth. Radiographically, all cases were radiolucent (100%), unilocular, and exhibited unerupted or impacted teeth, as well as displaced teeth. Histologically, all cases showed thin stratified squamous epithelium, with 60% having loose connective tissue, 80% fibrous tissue, and 20% collagenous tissue. Inflammation was noted in 40% of cases, and cholesterol clefts were observed in 20% of the luminal connective tissue. These findings are consistent with studies by Silna Babuji et al.[11], Erzurumlu Zerrin et al.[12], Hung-Pin Lin et al.[13] The posterior mandible is the most commonly involved site, followed by the maxillary posterior region. DCs develop around unerupted or impacted teeth due to fluid accumulation between the follicular epithelium and the tooth, with impacted third molars and upper canines being the primary causes.[7,19,13,14] (Table 1)

For OKC, the most common age group was 21-40 years, with females being the most commonly affected. Clinically, it presented as swellings, primarily in the mandibular posterior region (82.14%). Among the cases, 14.28% had partially erupted teeth, 35.71% had unerupted or impacted teeth, and 10.71% had over-retained deciduous teeth. Radiographically, 53.57% were radiolucent and 46.42% were mixed lesions, with scalloping evident in 85.71%. Fourteen percent were unilocular, while 85.71% were multilocular, and 50% were associated with unerupted or impacted teeth. Histologically, 53.57% exhibited thin lining epithelium, with all cases showing stratified squamous cells. Parakeratin and basal cell palisading were observed in all cases, and most had fibrous connective tissue (71.42%). Inflammation was noted in 78.57% of cases, with a corrugated appearance in 57.14% of the luminal connective tissue, and 78.57% showed daughter cysts. The findings were similar to those of Wang Yan-jin et al.[15] and Dr. Mohammad Asifur Rahman et al.[16] (Table 1)

In OOCs, all cases (100%) were in the age group of 21-40 years, with an equal distribution of gender. Clinically, it presented with swelling and was associated with missing or unerupted teeth. Radiographically, lesions were radiolucent, unilocular, and had scalloped borders with displacement. Histologically, all had a thin epithelial lining with orthokeratin and collagenous connective tissue showing an onion-skin appearance. These findings align with Qing Dong et al.[17], Nasir Uddin et al.[18], and D B Nandini et al.[19] (Table 1)

In present study, the most common age group for ameloblastoma was 21-40 years, with males being the most commonly affected. Clinically, it presented as swelling, mainly in the mandibular posterior region (76.92%). Eggshell cracking was seen in 76.92%, while 15.38% had tooth mobility, displacement, and partially erupted or impacted teeth. Radiographically, all were mixed, multilocular, with scalloped borders; 53.84% had a honeycomb, and 15.38% showed a soap bubble appearance, with root resorption in all cases. Histologically, 84.61% had thin lining epithelium, 76.92% had tall-columnar cells with fibrous connective tissue, and 46.15% had daughter cysts.

These findings were consistent with other studies.[20,21] (Table 1)

Cytokeratins (CK) are fundamental markers for epithelial cell differentiation, and their expression varies by region and can be modified by pathological processes. CK19, the smallest cytokeratin, is unique as it lacks the typical domain and is consistently expressed in normal and pathological odontogenic epithelia.[5,22] Although the overall p-value for CK19 expression across all lesions was not statistically significant (Table 2), the intergroup comparison showed a significant p-value of 0.01 ($p < 0.05$). (Table 3)

In the present study, CK 19 expression in RCs was positive in 64.28%, similar to Yvonne Wagner et al.[23], who reported 68.4%, and Vikas Parshottam Bhakhar et al.[6], who reported 100%. Christian Stoll et al.[24] found 47% positivity. In terms of expression patterns in the present study, 55.55% showed staining throughout the entire epithelial thickness, 11.11% in more than one layer, and 33.33% in a single layer. Vikas Bhakhar et al.[6] found 45% staining throughout the entire thickness, similar to this study, while other patterns differed. Christian Stoll et al.[24] reported 47% staining in suprabasal layers. (Table 2 & 3) (**Figure 1** (**C**))
In this study, 80% of DCs showed positive CK 19 expressions. Vikas Bhakhar et al.[6] and Kamath KP et al.[25] reported a 100% positivity rate, while Aesha Imran et al.[5] and Christian Stoll et al.[24] reported 20% and 50%, respectively. In this study, 75% showed staining throughout the entire thickness, and 25% had staining in more than one layer, aligning closely with VikaS ParShottam Bhakhar et al.[6]'s findings. In contrast, Aesha Imran et al.[5] and Kamath KP et al.[25] reported varying expression intensities, and Miyako Hoshino et al.[26] noted reactivity in all layers except the basal layer. (Table 2 & 3) (**Figure 2** (**C**))

In the present study, 60.71% of OKC cases were positive for CK 19, aligning with Kamath KP et al.[25] (60%) and Vikas Parshottam Bhakhar et al.[6] (75%). However, Vipul Mohan Pawar et al.[26] reported 100% positivity, while studies by Aesha Imran et al.[5] and Christian Stoll et al.[24] found complete negativity for CK 19. In our cases, 17.64% showed staining throughout the full thickness, 64.70% in multiple epithelial layers, and 17.64% in a single layer, similar to the findings of Vikas Parshottam Bhakhar et al.[6] For Kamath KP et al.[25], 40% showed '+' and 20% showed '++'. Miyako Hoshino et al.[27] found staining in all layers except the basal layer. (Table 2 & 3) (**Figure 3** (**C**))

In present study, all OOC cases (100%) were negative for CK 19 expression, consistent with findings by Miyako Hoshino et al.[27] and Kaname Tsuji et al.[28]. However, Vipul Mohan Pawar et al.[26] reported a 50% positivity rate. (Table 2 & 3)

CK 19, an epithelial marker, is typically present in simple epithelia and basal cells of non-keratinized stratified squamous epithelia. Its expression in RCs, DCs, and OKCs suggests an odontogenic origin. According to Kaname Tsuji et al.[27], OOCs likely do not originate from odontogenic epithelium due to the absence of CK19 expression. In contrast, Vipul Mohan Pawar et al.[26] found mild CK19 expression in 50% of OOC cases, limited to the superficial layer, indicating a lower proliferative potential compared to the aggressive behavior seen in OKC and ameloblastoma. (Table 2)

In this study, 77.92% of Ameloblastoma cases were positive for CK19. Vipul Mohan Pawar et al.[26] and Heikinheimo K et al.[29] reported 100% positivity, while Aesha Imran et al.[5] found only 6.6% positivity. In the present study, 80% showed staining throughout the entire thickness, and 20% showed staining in multiple epithelial layers. This contrasts with Aesha Imran et al.[5], who reported only 6.6% for ++. K. Sudheer Kanth et al.[30] found diffuse staining in neoplastic cells, while Vipul Mohan Pawar et al.[26] reported 50% strong, 45% moderate, and 5% weak staining. CK19 expression in this study indicates odontogenic properties throughout neoplastic cells, including tall columnar and stellate reticulum-like cells.[30] (Table 2 & 3) (**Figure 4** (**C**))
Statistically significant p-values were observed between RC and OKC, which was 0.03 ($p < 0.05$), and between OKC and Ameloblastoma, which was 0.01 ($p < 0.05$). However, differences were noted in the comparison between other lesions, but they were not statistically significant. These results highlight distinct clinical, biological, and phenotypical differences between these lesions, suggesting that CK19 expression could serve as an additional diagnostic tool for differentiation. (Table 3)

CK staining interpretation is subjective, as it depends on the pathologist's evaluation, and there is a risk of masking epitopes, leading to false negatives. Differences in CK19 expression reports in RC, DC, OKC, OOC, and Ameloblastoma may result from varying antigen retrieval methods, monoclonal antibodies, or sample sizes. Smith et al. and Matthews et al. emphasized caution in interpreting negative results. Standardizing techniques could enhance understanding of these lesions' behavior and pathogenesis. CK19 expression is not consistent across lesions, as shown in this study. This study included a varying number of cases for each type of lesion, which could lead to imbalances in statistical power and potential biases in the result. Additionally, CK19 is only one of several molecular markers that may help differentiate various odontogenic lesions. Hence, further investigations with larger sample sizes to study the expression patterns of CK 19 epithelial markers may provide additional diagnostic parameters for better differentiation between these lesions.[6,22,27] Investigating additional epithelial markers alongside CK 19and incorporating advanced imaging techniques may provide better diagnostic parameters. Comprehensive and longitudinal studies could offer deeper insights into the pathogenesis and behaviour of odontogenic lesions, enhancing diagnostic accuracy.

5.Conclusion

CK19 expression serves as a valuable marker in the identification and differentiation of odontogenic cysts and tumors, contributing significantly to diagnostic accuracy. Its difference in the expression in lesions like RCs, DCs, OKC, and ameloblastoma offers insights into the epithelial origins and biological behaviour of these lesions. By aiding in distinguishing between more aggressive tumors, such as ameloblastoma, and less aggressive entities, CK19 helps in

treatment plans. Ultimately, CK19's application in diagnostic immunohistochemistry enhances prognosis estimation, making it an essential tool for making diagnosis.

Conflict of Interest: Not Applicable

Author Contributions:

Dr. Nikita Gayakwad: Conceptualization of the study, data collection, analysis, and drafting the manuscript.

Dr. Shilpa Parikh: Supervision and guidance throughout the study, critical review of the manuscript, and ensuring the methodological accuracy of the research.

Dr. Jigna Shah: Oversight as the Head of the Department, providing resources and infrastructure, and offering substantial intellectual input and critical revisions of the manuscript.

Dr. Priyanshi Jayesh Parikh: Contribution to literature review, supporting data analysis, and assisting with manuscript preparation.

Acknowledgments: Not applicable

References

[1] Hunter KD, Speight PM. The diagnostic usefulness of immunohistochemistry for odontogenic lesions. Head and neck pathology. 2014 Dec;8:392-9.
[2] Jeyaraj P. Diagnostic and Prognostic value of Immunohistochemistry in Destructive Paediatric Maxillary Pathologies. Journal of Immunological Sciences. 2020 Oct 6;4(4).
[3] Seidl M, Weinhold B, Jacobsen L, Rasmussen OF, Werner M, Aumann K. Critical assessment of staining properties of a new visualization technology: a novel, rapid and powerful immunohistochemical detection approach. Histochemistry and Cell Biology. 2020 Dec;154:663-9.
[4] Kamath KP, Vidya M. Cytokeratin 19 expression patterns of dentigerous cysts and odontogenic keratocysts. Annals of medical and health sciences research. 2015;5(2):119-23.
[5] Imran A, Ranganathan K, Rao UD, Joshua E, Thavarajah R. Expression of calretinin and cytokeratin 19 in radicular cyst, dentigerous cyst, odontogenickerato cyst, and ameloblastoma. Journal of Dr. NTR University of Health Sciences. 2016 Apr 1;5(2):118-22.
[6] Bhakhar VP, Shah VS, Ghanchi MJ, Gosavi SS, Srivastava HM, Pachore NJ. A comparative analysis of cytokeratin 18 and 19 expressions in odontogenic keratocyst, dentigerous cyst and radicular cyst with a review of literature. Journal of clinical and diagnostic research: JCDR. 2016 Jul;10(7):ZC85.
[7] Bhat A, Mitra S, Chandrashekar C, Solomon M, Kulkarni S. Odontogenic cysts and odontogenic tumors in a large rural area from India. A 10-year reflection. Medicine and Pharmacy Reports. 2019 Oct;92(4):408.
[8] Bahal M. Infected radicular cyst - a case report and review of literature. J Dent Maxillofacial Res. (2023);6(2):
[9] 54−56. DOI: 10.30881/jdsomr.00064Chen JH, Tseng CH, Wang WC, Chen CY, Chuang FH, Chen YK. Clinicopathological analysis of 232 radicular cysts of the jawbone in a population of southern Taiwanese patients. The Kaohsiung journal of medical sciences. 2018 Apr 1;34(4):249-54.
[10] Villasis-Sarmiento L, Portilla-Robertson J, Melendez-Ocampo A, Gaitan-Cepeda LA, Leyva-Huerta ER. Prevalence and distribution of odontogenic cysts in a Mexican sample. A 753 cases study. Journal of clinical and experimental dentistry. 2017 Apr;9(4):e531.
[11] Babuji S, Thelekkat Y, Philip R, Nazar J. DENTIGEROUS CYST IN A 10 YEAR OLD-A CASE REPORT AND REVIEW OF LITERATURE.
[12] Zerrin E, Husniye DK, Peruze C. Dentigerous cysts of the jaws: clinical and radiological findings of 18 cases. Journal of Oral and Maxillofacial Radiology. 2014 Sep 1;2(3):77-81.
[13] Lin HP, Wang YP, Chen HM, Cheng SJ, Sun A, Chiang CP. A clinicopathological study of 338 dentigerous cysts. Journal of oral pathology & medicine. 2013 Jul;42(6):462-7.
[14] Ruslin M, van Trikt KN, Tajrin A, Fauzi A, Rasul MI, Boffano P, Forouzanfar T. Epidemiology, treatment, and recurrence of odontogenic and non-odontogenic cysts in South Sulawesi, Indonesia: A 6-year retrospective study. Journal of Clinical and Experimental Dentistry. 2022 Mar;14(3):e247.
[15] Wang YJ, Xie XY, Hong YY, Bai JY, Zhang JY, Li TJ. Clinicopathological analysis of 844 cases of odontogenic keratocysts. Beijing da xue xue bao. Yi xue ban= Journal of Peking University. Health Sciences. 2020 Feb 1;52(1):35-42.
[16] Rahman MA, Rahman T, Haider IA. A clinicopathological study and management of odontogenic keratocyst. Update Dental College Journal. 2019 Apr 27;9(1):8-15.
[17] Dong Q, Pan S, Sun LS, Li TJ. Orthokeratinized odontogenic cyst: a clinicopathologic study of 61 cases. Archives of pathology & laboratory medicine. 2010 Feb 1;134(2):271-5.
[18] Uddin N, Zubair M, Abdul-Ghafar J, Khan ZU, Ahmad Z. Orthokeratinized odontogenic cyst (OOC): Clinicopathological and radiological features of a series of 10 cases. Diagnostic pathology. 2019 Dec;14:1-7.
[19] Nandini DB, Devi TP, Deepak BS, Sanjeeta N. Incidental finding of orthokeratinized odontogenic cyst with unusual features. Journal of Oral and Maxillofacial Pathology. 2022 Jan 1;26(1):130.
[20] CHANDRAKALA J, SAHANA N, SUGANYA G, TAHASILDAR J, JOSE M, MURUGESH J, RENUGA S, VERGHESE R. Prevalence of Odontogenic Tumours: A Study of 122 Cases among Karnataka Population. Journal of Clinical & Diagnostic Research. 2023 Jan 1;17(1).
[21] Figueiredo NR, Dinkar AD, Meena M, Satoskar S, Khorate M. Ameloblastoma: A clinicoradiographic and histopathologic correlation of 11 cases seen in Goa during 2008-2012. Contemporary clinical dentistry. 2014 Apr 1;5(2):160-5.

[22] Akhila CN, Sreenath G, Prakash AR, Kanth MR, Reddy AV, Kumar SN. Expression of stem cell marker cytokeratin 19 in reduced enamel epithelium, dentigerous cyst and unicystic ameloblastoma–A comparative analysis. Journal of Oral and Maxillofacial Pathology. 2021 Jan 1;25(1):136-40.
[23] Wagner Y, Filippi A, Kirschner H, Dreyer T. Zytokeratin-und p53-Expression odontogener Zysten. Oral and Maxillofacial Surgery. 1999 Sep 1;3(5):263.
[24] Stoll C, Stollenwerk C, Riediger D, Mittermayer C, Alfer J. Cytokeratin expression patterns for distinction of odontogenic keratocysts from dentigerous and radicular cysts. Journal of oral pathology & medicine. 2005 Oct;34(9):558-64.
[25] Kamath KP, Vidya M. Cytokeratin 19 expression patterns of dentigerous cysts and odontogenic keratocysts. Annals of medical and health sciences research. 2015;5(2):119-23.
[26] Pawar VM, Patel S, Pathak J, Swain N, Hosalkar R, Iyer J. Immunohistochemical evaluation of calretinin and cytokeratin-19 in odontogenic keratocyst and ameloblastoma: a retrospective study. Journal of Contemporary Dentistry. 2015 May;5(2):98-103.
[27] Hoshino M, Inoue H, Kikuchi K, Miyazaki Y, Yoshino A, Hara H, Terui T, Kusama K, Sakashita H. Comparative study of cytokeratin and langerin expression in keratinized cystic lesions of the oral and maxillofacial regions. Journal of oral science. 2015;57(4):287-94.
[28] Tsuji K, Wato M, Hayashi T, Yasuda N, Matsushita T, Ito T, Gamoh S, Yoshida H, Tanaka A, Morita S. The expression of cytokeratin in keratocystic odontogenic tumor, orthokeratinized odontogenic cyst, dentigerous cyst, radicular cyst and dermoid cyst. Medical molecular morphology. 2014 Sep; 47:156-61.
[29] Heikinheimo K, Hormia M, Stenman G, Virtanen I, Happonen RP. Patterns of expression of intermediate filaments in ameloblastoma and human fetal tooth germ. Journal of Oral Pathology & Medicine. 1989 May;18(5):264-73.
[30] Kanth KS, Kumar TS, Kumar AR. Immunohistochemical analysis of dentigerous cyst and ameloblastoma using cytokeratin 19 & 14, p53, p63 and ki-67. SRM Journal of Research in Dental Sciences. 2012 Oct 1;3(4):236

Table 1: Demographic distribution, Clinical, Radiographic and Histologic features of the odontogenic cysts and tumours

Features	Odontogenic cysts and tumors (n= 62)				
	RC n= 14 (%)	DC n= 5 (%)	OKC n= 28 (%)	OOC n= 2 (%)	Ameloblastoma n= 13 (%)
Age					
0-20 years (n=16)	5 (35.71)	2 (40)	7 (25)	0	2 (15.38)
21-40 years (n=33)	8 (57.14)	2 (40)	13 (46.43)	2 (100)	8 (61.54)
41-60 years (n=9)	0	0	7 (25)	0	2 (15.38)
61-80 years (n=4)	1 (7.14)	1 (20)	1 (3.57)	0	1 (7.69)
Gender					
Male (n=33)	10 (71.42)	1 (20)	13 (46.42)	1 (50)	8 (61.53)
Female (n=29)	4 (28.57)	4 (80)	15 (53.57)	1 (50)	5 (38.46)
Clinical features					
Swelling	11 (78.57)	5 (100)	28 (100)	2 (100)	13 (100)
Maxillary anterior	8 (57.14)	2 (40)	1 (3.57)	0	0
Maxillary posterior	0	0	4 (14.28)	0	0
Mandibular anterior	1 (7.14)	1 (20)	0	1 (50)	3 (23.07)
Mandibular posterior	5 (35.71)	2 (40)	23 (82.14)	1 (50)	10 (76.92)
Egg shell cracking	0	0	0	0	10 (76.92)
Mobility of teeth	1 (7.14)	0	0	1 (50)	2 (15.38)
Teeth displacement/ Tilting/ Rotating	2 (14.28)	0	0	0	2 (15.38)
Partially erupted or impacted	0	1 (20)	4 (14.28)	0	2 (15.38)
Missing/Unerupted	0	4 (80)	10 (35.71)	2 (100)	2 (15.38)
Over retained deciduous teeth	0	1 (20)	3 (10.71)	1 (50)	0
Fractured teeth	8 (57.14)	0	0	0	0
Carious/ Discoloured teeth	4 (28.57)	0	0	0	0
Endodontically treated/ Restored teeth	2 (14.28)	0	0	0	0
Radiographic Features					
Radiopaque	0	0	0	0	0
Radiolucent	14 (100)	5 (100)	15 (53.57)	2 (100)	0
Mixed	0	0	13 (46.42)	0	13 (100)
Scalloping	0	0	24 (85.71)	2 (100)	13 (100)
Unilocular	14 (100)	5 (100)	4 (14.28)	2 (100)	0
Multi locular	0	0	24 (85.71)	0	13 (100)
Honey comb	0	0	0	0	7 (53.84)
Soap bubble	0	0	0	0	2 (15.38)
Unerupted/ Impacted tooth	0	5 (100)	14 (50)	2 (100)	4 (40.76)
Displaced	0	5 (100)	14 (50)	2 (100)	4 (40.76)
Root resorption	2 (14.28)	0	5 (17.85)	0	13 (100)
Histologic Features					

Epithelium	Thin		14 (100)	5 (100)	15 (53.57)	2 (100)	11 (84.61)
	Thick		0	0	13 (46.42)	0	3 (23.07)
	Type of cells	Stratified Squamous	14 (100)	5 (100)	28 (100)	2 (100)	0
		Cuboidal	0	0	0	0	3 (23.07)
		Tall Columnar	0	0	0	0	10 (76.92)
	Keratin	Ortho keratin	0	0	0	2 (100)	0
		Para keratin	0	0	28 (100)	0	0
		No keratin	14 (100)	5 (100)	0	0	0
	Basal cell palisading		0	0	28 (100)	0	0
	Ruston bodies in lining epithelium		3 (21.42)	0	0	0	0
Connective tissue	Loose		0	3 (60)	0	0	0
	Fibrous		14 (100)	4 (80)	20 (71.42)	0	10 (76.92)
	Collagenous		0	1 (20)	8 (28.57)	2 (100)	3 (23.07)
	Necrosis		9 (64.28)	0	0	0	0
	Inflammation		14 (100)	2 (40)	22 (78.57)	0	0
Luminal connective tissue	Hyaline bodies		5 (35.71)	0	0	0	0
	Cholesterol clefts		2 (14.28)	1 (20)	0	0	0
	Calcification		0	0	0	0	0
	Corrugated appearance		0	0	16 (57.14)	0	0
	Onion skin appearance		0	0	0	2 (100)	0
Daughter cyst			0	0	22 (78.57)	0	6 (46.15)

(RC= Radicular cyst, DC= Dentigerous cyst, OKC= Odontogenic keratocyst, OOC= Ortho keratinised odontogenic keratocyst)

Table 2: Expression of CK19 in odontogenic cysts and tumors

Lesion		CK 19 expression	
		Positive n= 40 (%)	**Negative n= 22 (%)**
Odontogenic cysts (n= 49)	RC (n= 14)	9 (64.28)	5 (35.71)
	DC (n= 5)	4 (80)	1 (20)
	OKC (n= 28)	17 (60.71)	11 (39.28)
	OOC (n= 2)	0	2 (100)
Odontogenic tumors (n = 13)	Ameloblastoma (n= 13)	10 (77.92)	3 (23.07)
P value		**0.27**	

chi square test, *P≤0.05 significant, **P<0.001 highly significant

(RC= Radicular cyst, DC= Dentigerous cyst, OKC= Odontogenic keratocyst, OOC= Ortho keratinised odontogenic keratocyst)

Table 3: Inter group and Intra-group comparison of patterns of cytokeratin 19 expression in odontogenic cysts and tumors

Comparison	CK 19 expression			P value
	Grade I (+)	**Grade II (++)**	**Grade III (+++)**	
Inter group comparison				
RC n= 9 (%)	3 (33.33%)	1 (11.11)	5 (55.55)	0.01*
DC n= 4 (%)	0	1 (25)	3 (75)	
OKC n= 17 (%)	3 (17.64)	11 (64.70)	3 (17.64)	
Ameloblastoma n= 10 (%)	0	2 (20)	8 (80)	
Intra-group comparison				
RC n= 9 (%)	3 (33.33)	1 (11.11)	5 (55.55)	0.29
DC n= 4	0	1 (25)	3 (75)	

(%)				
RC n= 9 (%)	3 (33.33)	1 (11.11)	5 (55.55)	0.03*
OKC n= 17 (%)	3 (17.64)	11 (64.70)	3 (17.64)	
RC n= 9 (%)	3 (33.33)	1 (11.11)	5 (55.55)	0.14
Ameloblastoma n= 10 (%)	0	2 (20)	8 (10)	
DC n= 4 (%)	0	1 (25)	3 (75)	0.07
OKC n= 17 (%)	3 (17.64)	11 (64.70)	3 (17.64)	
DC n= 4 (%)	0	1 (25)	3 (75)	0.61
Ameloblastoma n= 10 (%)	0	2 (20)	8 (10)	
OKC n= 17 (%)	3 (17.64)	11 (64.70)	3 (17.64)	0.01*
Ameloblastoma n= 10 (%)	0	2 (20)	8 (10)	

chi square test, *P≤0.05 significant, **P<0.001 highly significant
(RC= Radicular cyst, DC= Dentigerous cyst, OKC= Odontogenic keratocyst, OOC= Ortho keratinised odontogenic keratocyst)

Figures

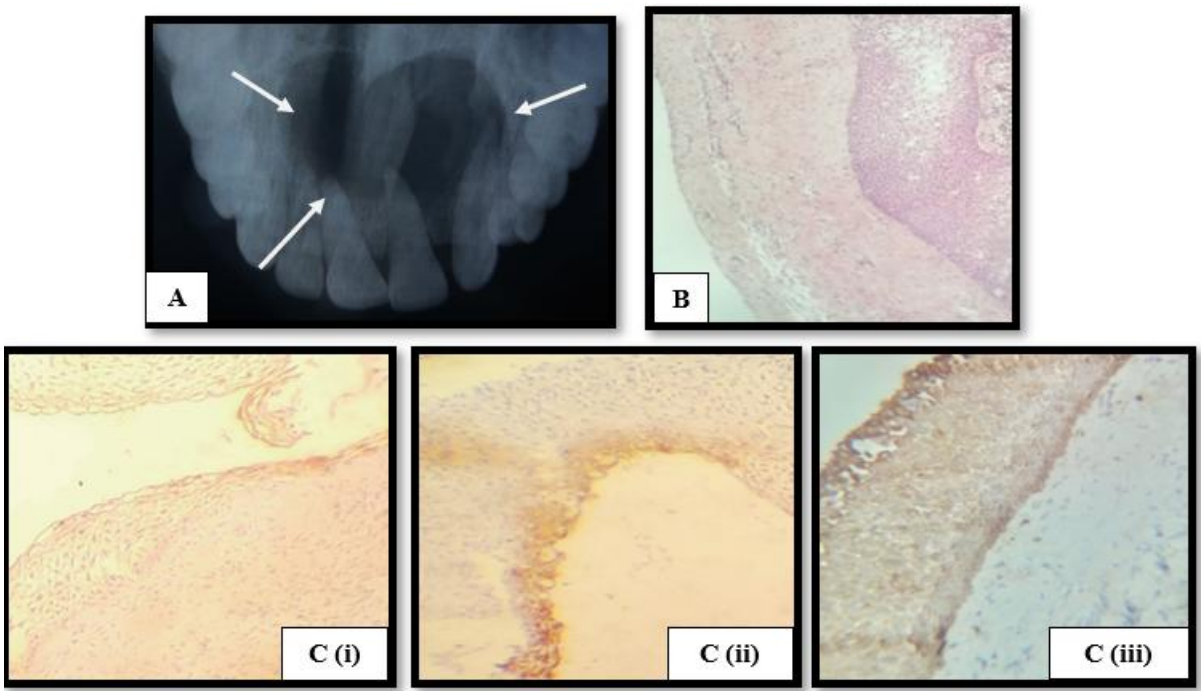

Figure 1: Radicular Cyst
(A) AND (B) SHOWING RADIOGRAPHIC AND HISTOLOGICAL FINDINGS OF THE RADICULAR CYST (C) IHC STAINING (CK 19), (I) GRADE I (+, SURFACE LAYER)**, (II) GRADE II** (++, SURFACE AND SPINOUS LAYER) **(III) GRADE III** (+++, SURFACE, SPINOUS AND BASAL LAYER)

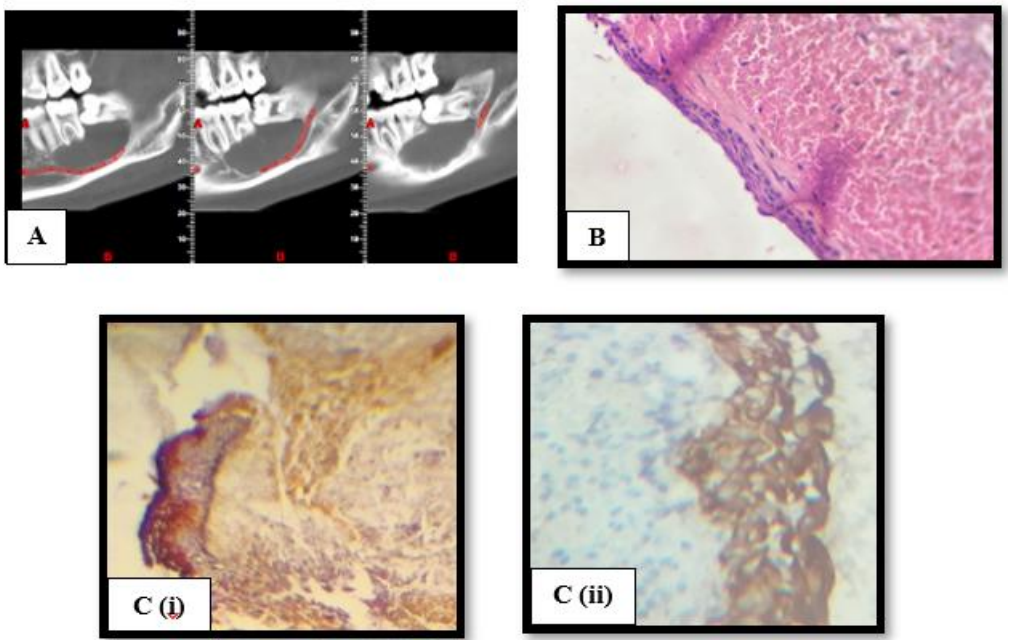

Figure 2: Dentigerous Cyst

(A) AND (B) SHOWING RADIOGRAPHIC AND HISTOLOGICAL FINDINGS OF DENTIGEROUS CYST (C) IHC STAINING (CK 19), (I) GRADE II (++, SURFACE AND SPINOUS LAYER) **(II) GRADE III** (+++, SURFACE, SPINOUS AND BASAL LAYER)

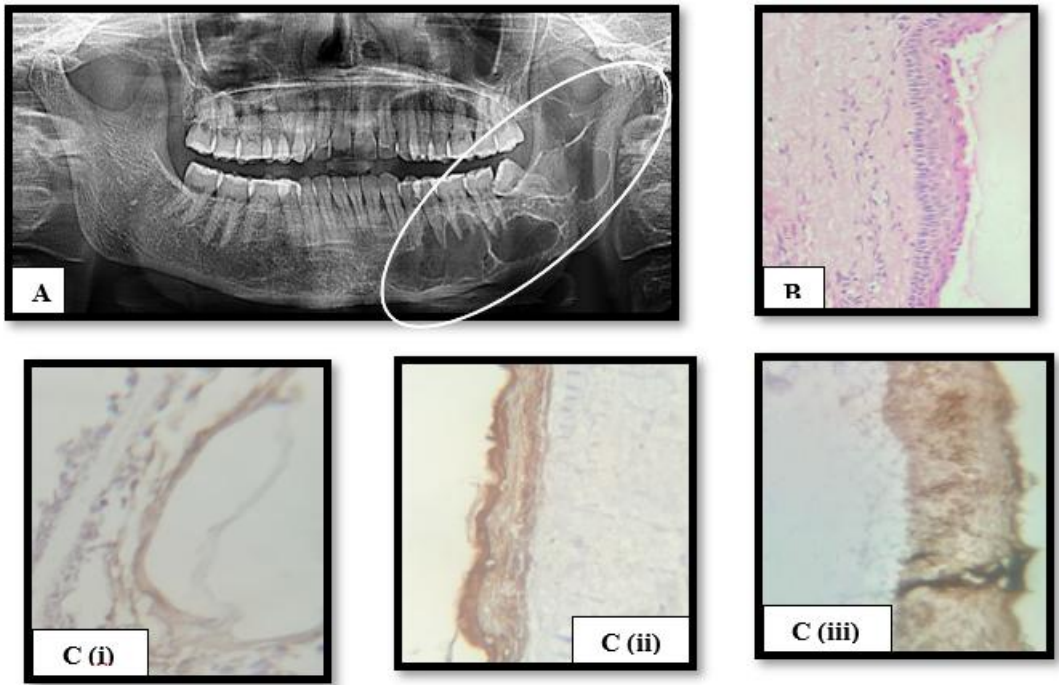

Figure 3: OKC

(A) AND (B) SHOWING RADIOGRAPHIC AND HISTOLOGICAL FINDINGS OF OKC (C) IHC STAINING (CK 19), (I) (GRADE I (+, SURFACE LAYER)**, (II) GRADE II** (++, SURFACE AND SPINOUS LAYER) **(III) (40X) GRADE III** (+++, SURFACE, SPINOUS AND BASAL LAYER)

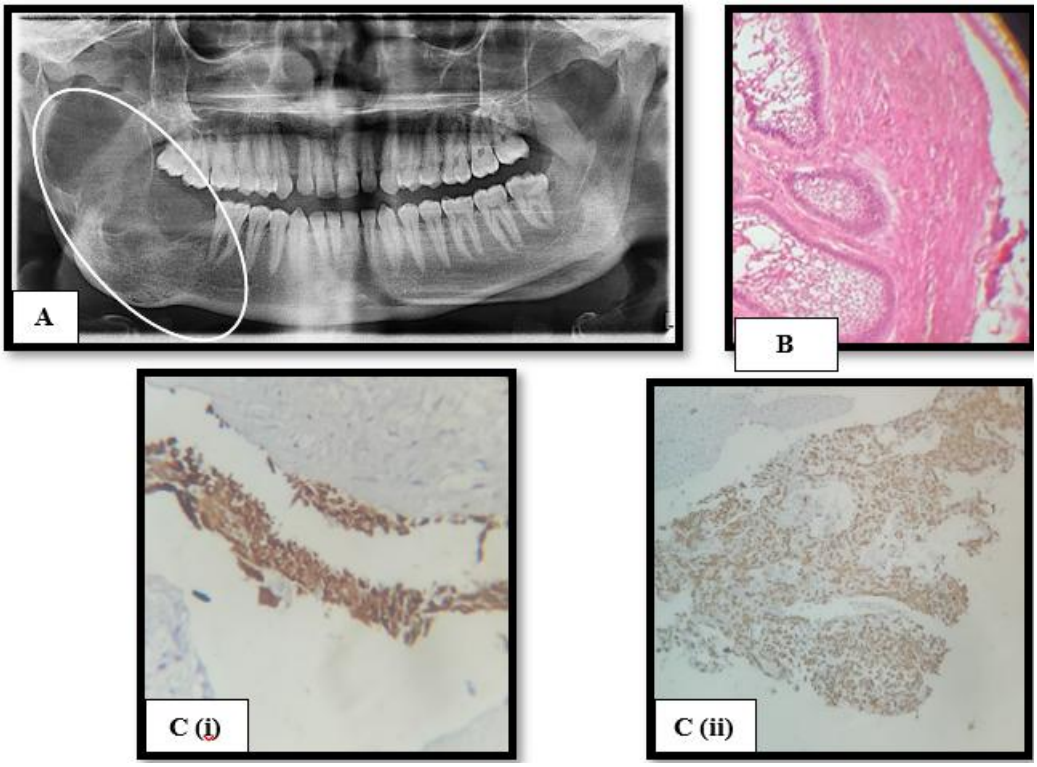

Figure 4: Ameloblastoma
(A) AND (B) SHOWING RADIOGRAPHIC AND HISTOLOGICAL FINDINGS OF AMELOBLASTOMA (C) IHC STAINING (CK 19), (I) GRADE II (++, SURFACE AND SPINOUS LAYER) **(II) GRADE III** (+++, SURFACE, SPINOUS AND BASAL LAYER)