International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 22s, 2025
https://theaspd.com/index.php

"Paxillin A Diagnostic Biomarker: Immunohistochemical Comparison Between Ameloblastoma And Odontogenic Keratocyst"

Dr. Pragati Gupta [1], Dr. Kartikay Saxena[2], Dr. Shilpa Dutta Malik[3], Dr Amit Kumar Joseph[4], Dr Shipra Saxena[5], Dr Mohammad Zanul Abedeen[6]

[1*]IIIrd year Post graduate student, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.), India
[2]Professor and Head, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.), India
[3]Associate professor, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.), India
[4]Associate Professor, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.), India
[5]Associate Professor, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.), India
[6]Assistant Professor, Department of Oral Maxillofacial Pathology and Oral Microbiology, Teerthanker Mahaveer University, Moradabad, (U.P.),India

Abstract

INTRODUCTION- *Paxillin, a cytoskeletal adaptor protein, is implicated in tumorigenesis and cellular proliferation, making it a promising therapeutic target for odontogenic tumors and cysts. Understanding its molecular signaling may aid in developing novel therapies to reduce recurrence and invasiveness. This study evaluates Paxillin expression in odontogenic keratocysts and ameloblastomas, aiming to support future research on targeted inhibitors and personalized treatment strategies.*

AIM-: *To evaluate and compare immune histochemical expression of paxillin in Ameloblastoma and Odontogenic keratocyst.*

OBJECTIVE*: 1. To identify and quantify immuno-histochemical expression of paxillin in histopathological confirmed cases of Ameloblastoma (group 1) 2. To identify and quantify Immuno- Histochemical Expression of paxillin in histopathological confirmed cases of Odontogenic keratocyst. (Group 2) 3. To evaluate and co- relate the findings within and between the group.*

MATERIALS AND METHODOLOGY- *This cross-sectional study analyzed 56 formalin-fixed, paraffin-embedded tissue specimens—comprising 28 ameloblastoma and 28 odontogenic keratocyst cases. Immunohistochemical staining was performed using anti-paxillin (PXN) antibody.*

RESULTS: *Paxillin expression in ameloblastomas was mainly peripheral, especially in proliferative zones, whereas OKCs showed positivity in basal and suprabasal epithelial layers. Moderate staining was observed in 35.71% of cases, weak in 58.93%, and negative expression occurred in 5.36% (only in OKCs). Ameloblastomas showed a higher mean staining score (4.71 ± 1.41) than OKCs (3.64 ± 1.41), with statistical significance noted only for staining scores.*

CONCLUSION: *Elevated paxillin expression in ameloblastoma underscores its aggressive nature. Targeting paxillin family proteins and their downstream signaling pathways may offer valuable diagnostic and therapeutic opportunities.*

KEYWORDS: *Paxillin, Ameloblastoma, odontogenic tumours, odontogenic keratocyst and Odontogenic cyst.*

INTRODUCTION-

Odontogenic keratocysts (OKCs) and ameloblastomas are locally aggressive lesions characterized by high recurrence rates and overlapping clinical and radiographic features. [1,2]OKC is classified as an odontogenic cyst with tumor-like behavior ,whereas ameloblastoma is a benign odontogenic neoplasm with infiltrative growth .Accurate diagnosis and tailored management are essential to reduce recurrence and local tissue destruction [3].
Histopathological and molecular markers—such as Ki-67, p53, Bcl-2, matrix metalloproteinases (MMP-2, MMP-9), epidermal growth factor receptor (EGFR), and Cyclin D1—are critical in differentiating OKC and ameloblastoma from less aggressive entities [4]. Ki-67 and p53 are associated with cellular proliferation and neoplastic potential in both lesions. Bcl-2 contributes to resistance against apoptosis, indicating a capacity for

local persistence . MMPs facilitate extracellular matrix degradation and bone resorption, further promoting invasion . EGFR and Cyclin D1 correlate with recurrence and may guide therapeutic responsiveness [5].
Paxillin, a cytoskeletal adaptor protein involved in focal adhesion kinase (FAK) and Src signaling, has recently emerged as a molecular biomarker with diagnostic and therapeutic implications. Its overexpression enhances cell migration, adhesion, and survival—hallmarks of aggressive tumor behavior . In OKC and ameloblastoma, elevated paxillin expression has been linked to increased proliferative activity, recurrence, and invasiveness [6].
Given paxillin's molecular involvement in tumor progression and its expression in aggressive odontogenic lesions, the present study was designed to evaluate its immunohistochemical profile in ameloblastoma and OKC and to explore its potential utility in clinical decision-making.

MATERIAL AND METHODOLOGY-
A cross-sectional observational study. Conducted in the Department of Oral and Maxillofacial Pathology and Oral Microbiology, TMDC & RC, using formalin-fixed, paraffin-embedded archival tissue specimens of ameloblastoma and odontogenic keratocyst (OKC). The estimated sample size was 56 (28 cases per group).The study included 56 histopathologically confirmed archival specimens segmented into:Group 1 (n = 28): Ameloblastoma, Group 2 (n = 28): OKC. Ethical Clearance was Approved by the Institutional Review Board (IRB), TMDC & RC, TMU, Moradabad.
AIM-: To evaluate and compare immune histochemical expression of paxillin in Ameloblastoma and Odontogenic keratocyst.
OBJECTIVE-: 1. To identify and quantify immuno-histochemical expression of paxillin in histopathological confirmed cases of Ameloblastoma (group 1)
2. To identify and quantify Immuno- Histochemical Expression of paxillin in histopathological confirmed cases of Odontogenic keratocyst. (Group 2)
3. To evaluate and co- relate the findings within and between the group.

Inclusion Criteria
- Archival specimens histopathologically diagnosed as ameloblastoma or OKC.

Exclusion Criteria
- Specimens from patients with malignancy, systemic illness, or systemic medication.

H&E Staining Procedure Tissue sections (4 μm) were obtained using a semi-automatic microtome and mounted on egg albumin-coated slides via flotation bath. Sections were incubated at 60 °C for 5 minutes, deparaffinized in xylene (2×5 min), rehydrated through graded ethanol (100%, 90%, 70%), and washed with tap water. Staining involved Harris hematoxylin (3 min), acid alcohol dip, alkali water (1 min), followed by bluing (10–15 min), eosin (1% Eosin-Y, 10 min), and final dehydration, clearing in xylene, and mounting with DPX.
Immunohistochemical Staining Slides were APES-coated after HCl immersion, autoclaving, and acetone/APES treatment. FFPE tissue sections (4 μm) were mounted, incubated (37 °C overnight; 60 °C for 30 min), deparaffinized (3×5 min xylene), rehydrated, and washed in TRIS buffer. Antigen retrieval was performed using TRIS-EDTA (pH 9) in a pressure cooker (30 min). Endogenous peroxidase was blocked (3% solution), followed by incubation with anti-paxillin PXN rabbit monoclonal antibody (60 min). Visualization used PolyExcel Target Binder, PolyExcel PolyHRP, and DAB chromogen, followed by counterstaining with Mayer's hematoxylin and mounting. Controls included colon carcinoma (positive) and liver carcinoma (negative).
Paxillin Expression Identification and Scoring Positive cells exhibited brown cytoplasmic/perinuclear staining in ameloblastoma and OKC tissue. Expression was graded:
- 0: No staining
- 1: < 25% positive cells
- 2: 25–50%
- 3: 50–75%
- 4: > 75% Combined staining intensity and distribution scores were classified:
- 0: No expression
- 1–4: Weak

- 5–8: Strong

Later Data were analyzed using SPSS v20. Histoscores of paxillin expression in ameloblastoma and OKC were statistically compared. Normality was assessed via the Kolmogorov–Smirnov test. Parametric or non-parametric tests were applied accordingly. A p-value < 0.05 was considered statistically significant.

RESULTS AND OBSERVATION - A total of 56 formalin-fixed paraffin-embedded (FFPE) tissue blocks were analyzed, comprising two histologically confirmed groups: Group 1 (n = 28) ameloblastoma and Group 2 (n = 28) odontogenic keratocyst (OKC). All samples were sectioned at 4 μm and underwent hematoxylin and eosin (H&E) staining for diagnostic confirmation.

The mean age in the ameloblastoma group was 28.86 ± 3.0 years, while in the OKC group it was 29.86 ± 4.24 years. Gender distribution was similar across both groups (Group 1: 57% male, 43% female; Group 2: 61% male, 39% female). Chi-square test confirmed no statistically significant difference in sex distribution (p = 0.786).

Histological Subtypes

Among ameloblastoma cases, 39.3% (n = 11) were follicular and 60.7% (n = 17) were plexiform. All OKC cases were parakeratinized.

Paxillin Immunoreactivity

Paxillin staining intensity was classified as strong, weak, or negative:

- Strong staining: 21.3% in ameloblastoma (n = 12), 14.29% in OKC (n = 8)
- Weak staining: 28.57% in ameloblastoma (n = 16), 30.36% in OKC (n = 17)
- Negative staining: 0% in ameloblastoma, 5.4% in OKC (n = 3)

The chi-square analysis yielded a statistic of 3.83 (p = 0.147), indicating no significant association between staining intensity and lesion type.

Subtype-level comparison using the Kruskal–Wallis test demonstrated:

- Follicular ameloblastoma: 5.82 ± 1.47
- Plexiform ameloblastoma: 4.00 ± 0.79
- Parakeratinized OKC: 3.64 ± 1.41

Statistical significance was observed (p = 0.002).

Post-hoc pairwise comparisons using the Dunn–Bonferroni test showed:

- Follicular vs. Plexiform ameloblastoma: p = 0.004
- Follicular ameloblastoma vs. OKC: p = 0.001
- Plexiform ameloblastoma vs. OKC: p = 0.691

Staining Intensity and Quantitative Score Correlation

Strong staining correlated with significantly higher mean scores in both groups:

- Ameloblastoma: Strong (6.17 ± 0.72), Weak (3.63 ± 0.50)
- OKC: Strong (5.25 ± 0.46), Weak (3.53 ± 0.51)

DISSCUSSION-

Paxillin is a pivotal focal adhesion adaptor protein that orchestrates cellular migration and motility by recruiting structural and signaling molecules upon phosphorylation at key tyrosine and serine residues[7,8] Paxillin phosphorylation via Src and FAK facilitates anchorage-independent signaling and proliferation, essential traits of metastatic cancer cells [9,10].

Ameloblastoma, though benign, exhibits aggressive behavior. The present study revealed a mean age of 28.86 ± 3.0 years, slightly earlier than findings by Reichart et al. (mean: 35.9 years). A male predominance was observed, consistent with prior reports. OKC, reclassified as a cyst by the WHO in 2017, displays vigorous proliferation and recurrence, necessitating early intervention align with Speight PM et al [11]. The mean age in our study was 29.86 ± 4.24 years, aligning with previous observations by Rippin et al[12]., Woolgar et al[13], and Jones et al. [14], who reported bimodal age peaks at 10–29 and 50–64 years Male predominance in solitary OKCs, as shown in our cohort, concurs with Woolgar et al. [13].

This study focused on conventional ameloblastoma (SMA), revealing a predominance of the plexiform subtype, aligning with findings by Chawla et al. and Kaur H et al. [15,16]. Only parakeratinized odontogenic keratocysts (OKCs) were included, in accordance with the WHO's reclassification of orthokeratinized variants as distinct entities [17].

Paxillin expression was evident in the epithelial lining of both ameloblastoma and odontogenic keratocyst (OKC) lesions, with intense immunoreactivity observed in 35.71% of cases—21.43% in ameloblastoma and 14.29% in OKC. Although staining intensity differences were not statistically significant, staining scores showed a significant distinction between groups. Elevated paxillin expression may reflect its role in tumorigenesis via interaction with focal adhesion kinase (FAK), as previously described by Sarode SC et al. and Deramaudt TB et al. [18,19]. However, this study did not assess FAK directly, leaving its contributory role unresolved.

The higher paxillin levels in ameloblastoma, supported by Patil S et al. [20], may be linked to its neoplastic nature and invasive behavior. Notably, Rajendran Ret al[21] the follicular subtype showed significantly higher staining scores than plexiform ameloblastoma and OKC, possibly indicating greater aggressiveness.

Functionally, paxillin acts as a docking adaptor protein within focal adhesions, linking actin cytoskeleton and extracellular matrix (ECM). Its interaction with FAK is essential for cell adhesion, invasion, and migration in accordance with Turner CE[22]. Inflammatory cytokines, such as TNF-α, can activate FAK signaling, thereby influencing paxillin-mediated motility and adhesion similar to Sen S et al. [23] Yang WJ et al [24]also implicated paxillin in neovascularization and tumor progression.

Current literature on paxillin in OKC and ameloblastoma remains limited. Singh A et al. [25] reported elevated expression in ameloblastoma, but without statistical significance or mechanistic clarity. Limitations of this study include a small sample size and the omission of FAK assessment. Nonetheless, paxillin's elevated expression underscores its potential relevance in tumor progression. Future research should explore paxillin–cytoskeleton interactions and matrix-degrading processes to better elucidate its role in neoplastic behavior and therapeutic targeting.

CONCLUSION-

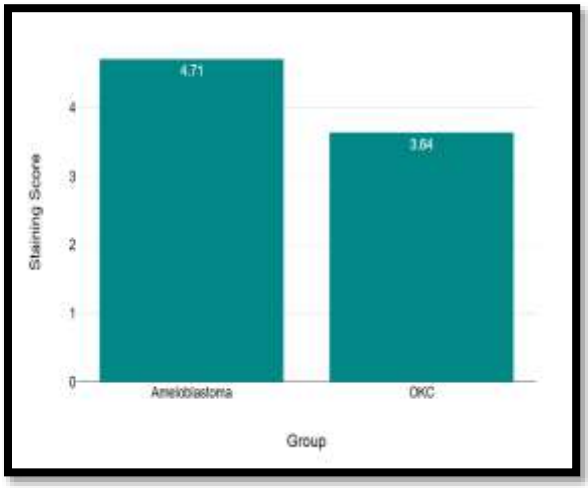
Paxillin's involvement in key tumorigenic pathways ranging from migration and adhesion to survival and angiogenesis underscores its functional importance in odontogenic lesions. With emerging evidence supporting paxillin-targeted therapies and gene-based interventions, it holds promise as a viable biomarker and therapeutic target. Future investigations should prioritize mechanistic clarity and clinical validation to establish its utility in prognostic and therapeutic frameworks.

REFERENCES

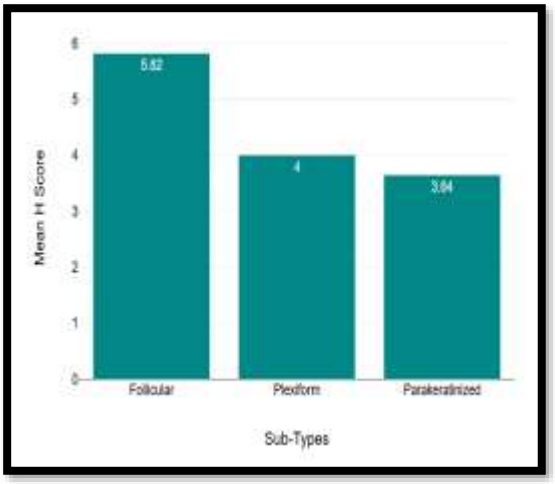
1. Philipsen HP, Reichart PA. Odontogenic Keratocyst: A Clinical, Radiographic And Histopathologic Study Of 205 Cases. Oral Oncol. 2001;37(3):240–5.
2. Singh HP, Bansal N, Kaur M. Ameloblastoma: Review Of Literature And Report Of Case. J Dent Sci Res. 2011;2(1):48–52
3. Neville BW, Damm DD, Allen CM, Chi AC. Oral And Maxillofacial Pathology. 4th Ed. St. Louis: Elsevier; 2016.
4. Reichart PA, Philipsen HP, Sonner S. Ameloblastoma: Biological Profile Of 3677 Cases. Eur J Cancer B Oral Oncol. 1995;31B(2):86–99.
5. Friedrich RE, Scheuer HA, Hutter W, Schmelzle R. Ameloblastoma Of The Jaws: Clinical, Radiological And Histopathologic Findings. Anticancer Res. 2005;25(3B):1577–84.
6. Gupta S, Ramanathan A, Ramnarayan A. Paxillin As A Biomarker In OKC And Ameloblastoma. J Oral Pathol Med. 2022;51(2):189–96.
7. Deakin NO, Turner CE. Paxillin Comes Of Age. J Cell Sci. 2008;121(Pt 15):2435–44.
8. Liu Y, Ma W, Zhang L, Et Al. Phosphorylation Of Paxillin In Cell Motility Regulation. Mol Biol Rep. 2010;37(3):1323–30.
9. Turner CE. Paxillin Interactions With Src And FAK Signaling. Curr Opin Cell Biol. 2000;12(5):593–9.
10. Chatterjee A, Jain S. Paxillin In Odontogenic Tumors: An Immunohistochemical Study. J Investig Clin Dent. 2020;11(3):E12361.
11. Speight PM, Takata T. Odontogenic Cysts And Tumors. Diagn Histopathol. 2018;24(6):240–50.
12. Rippin JW. Odontogenic Keratocyst Age And Sex Distribution. Br Dent J. 1977;143(3):84–8.
13. Woolgar JA, Rippin JW. Solitary Keratocyst: Age And Gender Trends. J Oral Pathol. 1984;13(6):519–26.

14. Jones AV, Craig GT, Franklin CD. Range And Frequency Of OKC Cases. Int J Oral Maxillofac Surg. 2006;35(7):680–4.
15. Chawla AS, Chaudhary S, Manuja N, Agarwal N. Immunohistochemical Analysis Of Ameloblastoma Subtypes. J Oral Maxillofac Pathol. 2016;20(2):203–7.
16. Kaur H, Sidhu M, Kaur G, Gaba S. Distribution Of Ameloblastoma Subtypes: A Clinicopathological Correlation. J Dent Res Rev. 2017;4(3):78–82.
17. El-Naggar AK Et Al. WHO Classification Of Head And Neck Tumours. 4th Ed. Lyon: IARC; 2017.
18. Sarode SC, Sarode GS. Paxillin–FAK Interaction In Tumor Aggressiveness. J Cancer Res Ther. 2014;10(4):940–4.
19. Deramaudt TB, Dujardin D. Paxillin Phosphorylation And Tumor Progression. Cell Motil Cytoskeleton. 2005;62(3):166–76.
20. Patil S, Rao RS, Sanketh DS, Agarwal A. Paxillin Expression In Odontogenic Lesions. J Oral Maxillofac Pathol. 2018;22(2):185–9.
21. Rajendran R, Sivapathasundharam B. Shafer's Textbook Of Oral Pathology. 7th Ed. New Delhi: Elsevier; 2012.
22. Turner CE. Paxillin As An Adaptor In Focal Adhesions. Curr Opin Cell Biol. 2000;12(5):593–9.
23. Sen S, Lang F, Kumar A. Inflammation-Induced Paxillin/FAK Signaling. Mol Cell Biochem. 2012;364(1–2):241–8.
24. Yang WJ, Yoon JK. Paxillin And Neovascularisation In Tumor Development. Exp Mol Med. 2015;47:E123.
25. Singh A, Verma P, Chandra S. Comparative Analysis Of Paxillin In OKC And Ameloblastoma. Indian J Pathol Microbiol. 2020;63(4):578–82.

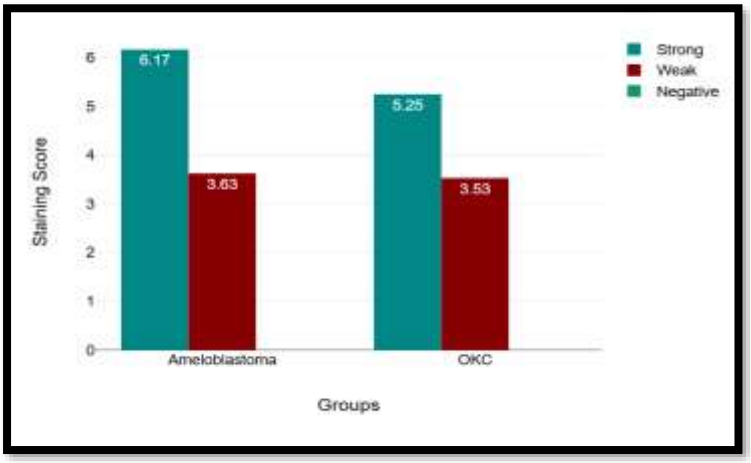
LEGENDS
GRAPHS



Graph 1- Mean staining score in study groups



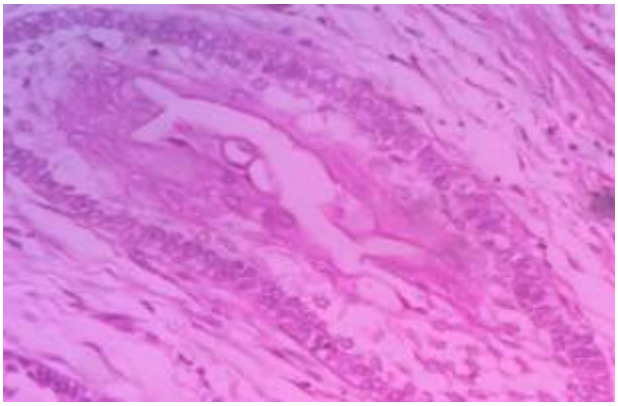
Graph 2 Mean staining score in subtypes of study groups



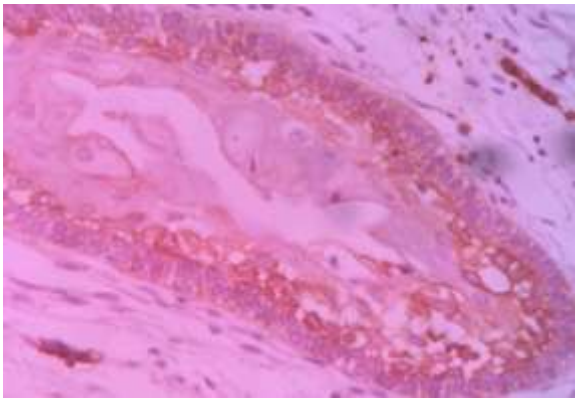
International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 22s, 2025
https://theaspd.com/index.php

Graph 3- Staining score according to staining intensity in study groups.

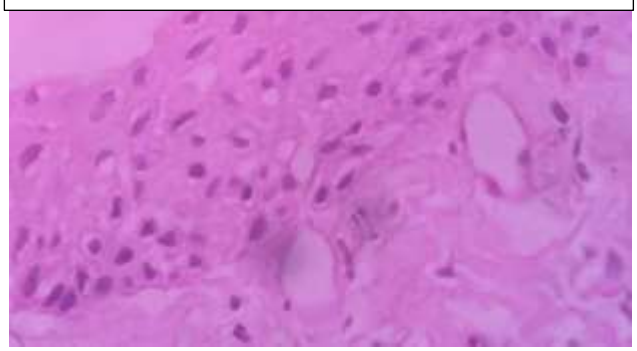
PHOTOMICROGRAPHS



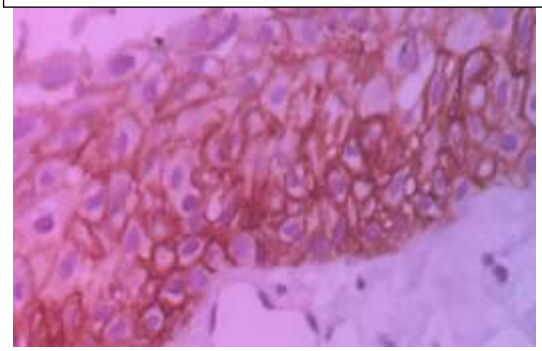
Photomicrograph 1-Paxillin IHC stained of ameloblastoma under 10 x magnifications



Photomicrograph 2- Paxillin IHC stained of ameloblastoma under 40x magnification



Photomicrograph 3- Paxillin IHC staining of OKC under 10x magnification



Photomicrograph 4- Paxillin IHC staining of OKC under 40x