Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Pierre Fauchard Academy

Journal homepage: https://www.jpfa.in/

Review Article

Revolutionizing oral pathology with artificial intelligence: The next diagnostic frontier

Anuradha Ojha[1], Deep Sharma[1]*, Ankita Singh[1], Jiji George[1]

[1]Dept. of Oral and Maxillofacial Pathology, College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh, India

Abstract

Artificial intelligence (AI) is poised to revolutionize oral pathology, with oral cancer diagnosis emerging as its major frontier, offering faster, more accurate, and accessible solutions that overcome the limitations of conventional methods. However, conventional diagnostic approaches such as histopathology and cytology are often limited by delayed turnaround times, which may hinder their early detection and treatment. In cytology and community-based screening, AI tools—including smartphone-based applications—are bridging gaps in low-resource settings by enabling scalable early detection. Digital histopathology involving AI-powered whole-slide image (WSI) analysis enables automated detection of OSCC, dysplasia, and precancerous lesions with improved reproducibility. Furthermore, prognostic and predictive models leveraging genomic and proteomic data are advancing personalized care, while adjunctive applications in radiology and salivary biomarker analysis expand AI's diagnostic scope. The integration of AI with precision medicine, explainable AI (XAI), AI-assisted education, and hybrid human–AI diagnostic models holds promise for shaping the next diagnostic frontier in oral pathology.

Despite these advances, barriers such as dataset biases, the lack of standardized digital pathology infrastructure, ethical issues related to data confidentiality and algorithm transparency, and the risk of over-reliance on AI remain critical limitations. Addressing these challenges is crucial for the safe and equitable adoption of clinical practices.

This article examines the role of AI development in oral pathology, highlighting its applications, benefits, problems, and future directions, and its role as a synergistic tool. This review assesses the application, diagnostic accuracy, efficiency and accessibility of AI, machine learning (ML) and Deep learning (DL) in oral pathology landscape.

Keywords: Artificial Intelligence (AI), Oral Pathology, Diagnostics, Machine Learning, Deep Learning, OSCC, Health Care

Received: 17-09-2025; **Accepted:** 30-09-2025; **Available Online**: 18-10-2025

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Oral pathology involves the diagnosis of potentially malignant oral disorders (OPMD) and represents a cornerstone in the detection of cancer arising in squamous cells within the oral cavity, contributing significantly to the global health burden. Oral squamous cell carcinoma (OSCC) is one of the most common neoplasms of the head and neck, characterised by delayed diagnosis and high mortality. Early and accurate diagnosis directly influences treatment outcomes and long-term survival rates.[1]

Conventional diagnostic methods, primarily histopathology and cytology have long served as the gold standard. While invaluable, these techniques have limitations. Histopathological interpretation relies heavily on the expertise of pathologists and is subject to inter-observer variability and subjectivity, which can result in inconsistent grading of dysplasia and OSCC.[2] Furthermore, pathology services often face workforce shortages and increasing caseloads, leading to diagnostic delays.[3] These challenges underscore the urgent need for tools that enhance reproducibility, efficiency, and diagnostic accuracy.

The advent of whole-slide imaging (WSI) has catalyzed a digital revolution in pathology, creating opportunities for integration with artificial intelligence (AI). AI—particularly automated machine learning (ML) and deep learning (DL)—has demonstrated considerable potential for analyzing

*Corresponding author: Deep Sharma
Email: pratap.mbi@gmail.com

https://doi.org/10.18231/j.jpfa.13337.1759220396
© 2025 The Author(s), Published by Innovative Publications.

complex images, detecting subtle histological changes, and supporting clinical decision-making.[4,5] In tumor pathology, AI has already been shown to complement, and in some cases outperform, human experts in pattern recognition, risk stratification, and prognostication.[6]

In oral pathology, AI is emerging as a transformative technology with applications across digital histopathology, exfoliative cytology, prognostic modeling, radiographic interpretation, and biomarker analysis.[5,7] These advancements not only promise improved accuracy and reproducibility but also have the potential to expand diagnostic services to underserved regions through mobile and cloud-based platforms.[8]

This article reviews the role of AI in oral pathology, emphasizing its applications, benefits, limitations, and future directions, while highlighting its function as a synergistic tool that supports pathologists in diagnosis and treatment prognosis.

2. Fundamentals of Artificial Intelligence in Pathology

Computer programs created to carry out tasks that often need human intelligence, like learning, reasoning, decision-making, and problem-solving, are referred to as artificial intelligence (AI).[9] Machine learning (ML) and deep learning (DL) are two subfields of artificial intelligence (AI) that have become very relevant in the study of pathology.

Machine learning (ML): As ML algorithms are exposed to more information, their prediction power increases as they discover patterns in structured data. Machine learning has been applied to pathology to predict illness outcomes, extract quantitative information, and automate image interpretation.[10]

Deep learning (DL): DL is a subclass of ML that models extremely complex, nonlinear relationships using artificial neural networks with numerous hidden layers. One kind of DL model that has shown particular effectiveness in pathology is convolutional neural networks (CNNs), which are used for object detection, segmentation, and picture classification.[11]

The integration of AI into pathology has primarily been driven by its utility in image analysis, pattern recognition, and predictive modeling. In histopathology, CNNs can identify architectural and cytological features that distinguish normal tissue from precancerous lesions and malignancies.[12] Similarly, ML algorithms can quantify tissue biomarkers, tumor-infiltrating lymphocytes, and angiogenesis, enabling precision diagnostics.[13]

AI has also been successfully applied to pattern recognition, where it identifies subtle morphologic variations that may be missed by the human eye. Predictive modelling extends AI's application into prognosis and treatment response, integrating multimodal data including histology, genomics, and proteomics.[14]

The journey of AI adoption in pathology has spanned several decades. Early attempts in the 1980s and 1990s focused on computer-assisted image analysis for cytology, but these methods were limited by computational capacity and digitization technology.[15] The widespread adoption of whole-slide imaging (WSI) in the 2000s marked a paradigm shift, enabling the digitization of entire histological slides at diagnostic resolution.[16]

With advances in computational power, open-source programming, and cloud storage, the past decade has witnessed an explosion in the application of DL algorithms in pathology. These models now support tumor detection, grading, and risk stratification with accuracy comparable to experienced pathologists.[17] Importantly, AI in pathology has transitioned from being a research novelty to an emerging clinical tool, supported by global efforts in digital pathology infrastructure.[18]

3. Applications of AI in Oral Pathology

3.1. Digital histopathology

Histopathology remains the gold standard for diagnosing oral lesions, including dysplasia, oral squamous cell carcinoma (OSCC), and other potentially malignant conditions. However, conventional microscopy is limited by inter-observer variability, high workload, and reporting delays, all of which can substantially affect diagnostic accuracy and patient outcomes.[19]

The advent of whole-slide imaging (WSI) has transformed traditional pathology into a digital platform, enabling the scanning of entire histological slides at diagnostic resolution.[1] This innovation provides the foundation for integrating AI-powered algorithms capable of analyzing gigapixel images rapidly and reproducibly.

3.1.1. Automated detection of oral squamous cell carcinoma and dysplasia

Convolutional neural networks (CNNs), a type of deep learning (DL) model, have shown encouraging results in the automated detection and categorization of OSCC. These models can identify histological patterns such as nuclear atypia, keratinization, and invasion depth, which are critical for grading OSCC.[5] By quantifying such features objectively, AI reduces the subjectivity associated with manual interpretation and improves reproducibility.

In addition, AI-assisted image analysis has been applied for the grading of epithelial dysplasia, which remains one of the most subjective areas of oral pathology. Studies report that DL models achieve diagnostic accuracy comparable to expert pathologists, with the potential to serve as an assistive tool in borderline or ambiguous cases.[6]

3.1.2. High-throughput and large-scale screening

AI systems integrated with WSI can process large datasets efficiently, making them highly suitable for population-level screening programs. For example, AI-driven digital pathology platforms have been explored for automated triage of precancerous lesions, prioritizing high-risk cases for review by pathologists. This approach could prove particularly beneficial in resource-limited settings where pathology expertise is scarce.[8]

3.1.3. Beyond diagnosis: Quantitative biomarker analysis

AI also extends its role beyond routine diagnosis. Algorithms can quantify tumor-infiltrating lymphocytes, angiogenesis, and stromal reactions, offering insights into the tumor microenvironment and potential biomarkers for therapy.[7] Such quantitative pathology opens avenues for personalized oncology by linking histological features to molecular pathways and therapeutic responses.

3.2. Role of AI in cytology and screening tools

Cytology, particularly exfoliative cytology, has long been recognized as a simple, minimally invasive method for early detection of oral lesions. However, its clinical utility has been limited by low sensitivity, inter-observer variability, and reliance on subjective interpretation.[19] This is where artificial intelligence (AI) has shown transformative potential, enhancing both the accuracy and accessibility of cytological screening.

3.2.1. Exfoliative cytology

Recent studies have demonstrated that AI-driven image analysis can automatically classify cytological smears, identifying atypical cells with high precision.[1] Deep learning (DL) algorithms are capable of recognizing nuclear abnormalities, variations in cell morphology, and chromatin patterns—parameters essential for differentiating between benign, premalignant, and malignant lesions.[5] Such automated systems reduce observer bias and provide standardized results, which are particularly valuable in large-scale screening.

3.2.2. Oral cancer screening

AI has also been integrated into screening platforms for oral cancer and precancerous conditions. Computer-aided cytological systems trained on thousands of labeled cell images have shown diagnostic accuracies comparable to trained cytopathologists.[6] These systems offer rapid, reproducible assessments and can serve as decision-support tools in community health programs.

3.2.3. Smartphone-based AI tools in low-resource settings

One of the most promising frontiers is the development of smartphone-based AI applications for oral cancer screening. Using smartphone-attached microscopes or high-resolution cameras, cytological images can be captured and analyzed by cloud-based AI algorithms.[8] This approach provides low-cost, scalable, and portable screening solutions, particularly for rural or underserved areas where access to pathology laboratories is limited.[16]

By integrating cytological screening with AI, there is a growing opportunity to establish community-level surveillance networks, enabling earlier detection of lesions and reducing the burden of late-stage oral cancer diagnosis.

3.3. AI in prognostic and predictive models

Artificial intelligence (AI) has become a potent tool in oral pathology for prognostic modeling and treatment prediction, going beyond diagnosis. OSCC and other oral malignancies are highly heterogeneous, with outcomes influenced by tumor biology, host immune response, and treatment modalities. Traditional prognostic systems, such as TNM staging and histopathological grading, often fail to capture this complexity.[19] AI models have the capacity to integrate multimodal data-histological, clinical, genomic, and proteomic-to generate personalized predictions.

3.3.1. Tumor grading and survival prediction

AI-based algorithms, particularly deep learning (DL) models, have been trained to grade tumors by analyzing histological parameters such as invasion depth, keratinization, and stromal reactions.[1] These automated grading systems provide standardized and reproducible assessments, reducing inter-observer variability. Moreover, survival prediction models leveraging AI have demonstrated improved accuracy compared to traditional staging alone, incorporating subtle features in tissue morphology that are not easily quantified by human observers.[5]

3.3.2. Treatment response prediction

In oncology, AI has also been applied to predict patient response to radiotherapy, chemotherapy, and immunotherapy. In oral pathology, integrating AI with radiogenomics—the correlation of imaging features with genomic profiles—holds potential to identify responders and non-responders to targeted therapies.[6] This strategy advances the goal of precision medicine, which aims to customize treatment based on the biology of each individual tumor.

3.3.3. Genomic and proteomic data integration

Another promising frontier is the integration of multi-omics data. Machine learning models can analyze large genomic and proteomic datasets, identifying signatures associated with recurrence, metastasis, or therapeutic resistance.[7] When combined with digital histopathology, these predictive models can uncover novel biomarkers that link morphology with molecular drivers, offering insights for both prognosis and therapeutic decision-making.[9]

3.3.4. Towards personalized oncology in oral pathology

The development of prognostic and predictive AI models has implications beyond individual patient management. At the population level, these tools can aid in risk stratification, surveillance planning, and resource allocation, thereby improving overall health system efficiency.[10]

3.4. Adjunctive tools

While histopathology and cytology remain central to oral pathology, adjunctive diagnostic tools such as radiology, salivary diagnostics, and molecular pathology are increasingly being augmented by artificial intelligence (AI). These complementary technologies enhance diagnostic precision, provide additional prognostic information, and support comprehensive patient management.

3.4.1. Radiographic interpretation

When diagnosing oral and maxillofacial diseases, imaging techniques such intraoral radiographs, orthopantomograms, and cone-beam computed tomography (CBCT) are essential. Traditionally, radiographic interpretation has been limited by human perception and variability among radiologists.

AI-based computer vision systems can detect pathologies such as jaw cysts, periapical lesions, and bone invasion in oral cancers with high sensitivity.[4] Deep learning (DL) models trained on CBCT datasets have shown effectiveness in identifying subtle bone changes, cortical perforation, and tumor spread that may be overlooked in conventional assessments.[3] Furthermore, automated OPG analysis using AI has been explored for early detection of malignancies and systemic disease indicators (e.g., osteoporosis, metabolic bone disease) that manifest radiographically.[6]

3.4.2. Salivary biomarker analysis

Saliva offers a non-invasive diagnostic medium enriched with DNA, RNA, proteins, metabolites, and microbiome signatures. Identifying reliable biomarkers in saliva for early oral cancer detection has been challenging due to complex molecular interactions. AI and machine learning (ML) can integrate these multidimensional datasets to identify diagnostic and prognostic signatures.[2]

For instance, AI-driven proteomic analysis of saliva has identified biomarker panels capable of distinguishing between oral squamous cell carcinoma (OSCC), potentially malignant disorders (PMDs), and healthy controls.[5] In resource-limited settings, coupling saliva-based point-of-care testing with AI-enabled cloud platforms could enable scalable, real-time cancer surveillance.

3.4.3. Molecular pathology

Molecular diagnostics—particularly genomic and transcriptomic profiling—are central to understanding the biological heterogeneity of oral cancers. However, these large datasets are often beyond the capacity of traditional statistical methods.

AI models are now being employed to integrate genomic alterations (e.g., TP53, NOTCH1 mutations), transcriptomic signatures, and protein expression data to predict tumor progression, recurrence risk, and therapy resistance.[7] Such AI-assisted molecular pathology enables the development of precision oncology strategies, linking molecular data with histological and clinical outcomes.[14]

3.4.4. Towards a multimodal diagnostic model

The integration of radiology, salivary biomarkers, and molecular pathology with histopathology through AI provides a multimodal diagnostic ecosystem. By combining morphological, radiographic, and molecular insights, AI has the potential to deliver holistic patient profiles, guiding personalized treatment strategies and improving survival outcomes.[15]

4. Advantages of AI in Oral Pathology

There are several advantages to incorporating artificial intelligence (AI) into oral pathology, which solves persistent problems with traditional diagnostic processes. These advantages span from improved diagnostic accuracy to broader applications in public health and education.

4.1. Enhanced accuracy and reproducibility

AI's capacity to lessen inter-observer variability is among its most important contributions. Traditional histopathological diagnosis often suffers from subjectivity, particularly in borderline cases such as oral epithelial dysplasia. AI-driven image analysis provides objective and standardized evaluations, ensuring greater diagnostic reproducibility.[12] Furthermore, deep learning models can recognize subtle histomorphological patterns that may be overlooked by human experts, thereby improving sensitivity in detecting early malignancies.[17]

4.2. Speed and efficiency in large-scale screening

The ability of AI to process gigapixel whole-slide images (WSI) rapidly makes it invaluable for large-scale oral cancer screening initiatives. Automated triage systems can prioritize high-risk cases for pathologists, significantly reducing turnaround times while maintaining quality.[15] This efficiency is particularly important in countries with a high oral cancer burden but limited numbers of trained pathologists.

4.3. Potential for early detection in public health

AI holds enormous promise in community-level and resource-limited settings. Smartphone-based AI screening tools allow frontline health workers to capture cytology or photographic images that are analyzed remotely using AI-powered platforms. Such innovations bring early detection and preventive strategies to underserved populations, potentially reducing late-stage diagnoses.[8]

4.4. Assistive role for pathologists (Augmented Intelligence)

Rather than replacing human expertise, AI functions as a decision-support system, enhancing pathologists' efficiency and confidence. Studies suggest that the best outcomes occur when AI is used in synergy with expert interpretation, a paradigm referred to as augmented intelligence.[9] This collaborative model allows pathologists to focus on complex cases, while routine or low-risk cases are streamlined by AI support.

4.5. Educational and training applications

Beyond clinical diagnosis, AI-driven platforms are also being deployed in oral pathology education. Virtual training modules powered by AI can provide instant feedback to students, simulate complex diagnostic scenarios, and even evaluate learners' performance against gold-standard datasets.[11] This has the potential to revolutionize oral pathology training, making it more interactive and standardized worldwide.

5. Challenges and Limitations

Artificial intelligence (AI) has the potential to revolutionize oral pathology, but there are also major obstacles and restrictions that need to be overcome before it is widely used in clinical settings.

5.1. Data quality and dataset biases

The caliber and variety of training datasets have a significant impact on AI algorithms. Many existing datasets in oral pathology are limited in size and often collected from single institutions, leading to biases that reduce generalizability.[14] For example, variations in slide preparation, staining techniques, and imaging platforms can affect AI performance when applied across different laboratories or populations. Without standardized, multi-institutional datasets, AI models risk producing unreliable or biased outcomes.[17]

5.2. Lack of standardized digital pathology infrastructure

The adoption of AI in histopathology is closely linked to the availability of whole-slide imaging (WSI) systems and digital storage infrastructure. However, access to high-resolution scanners, cloud storage, and processing resources is insufficient in many places, particularly in low- and middle-income nations.[2] This digital divide poses a barrier to equitable implementation of AI-powered diagnostics.

5.3. Ethical and legal concerns

Privacy, permission, and security are among the ethical and legal issues brought up by the use of health data in AI. Although large datasets used to train AI models must abide by data protection laws like GDPR and HIPAA, confidentiality violations are still a worry.[9] Another issue is the "black box" problem, where AI models generate predictions without clear reasoning, limiting transparency and accountability.[7] Such opacity undermines clinicians' trust in AI-driven diagnostic outputs.

5.4. Risk of over-reliance on AI vs. Human expertise

While AI offers efficiency, there is a risk of over-reliance on automated systems. Inaccuracies or biases in AI algorithms could lead to diagnostic errors if human oversight is reduced. Experts warn that rather than taking the role of qualified pathologists, AI should be viewed as an aid.[10] A balanced human–AI hybrid model is essential to safeguard diagnostic quality and patient safety.

5.5. Cost and implementation barriers

Establishing AI-based workflows requires substantial investments in infrastructure, training, and maintenance. Additionally, regulatory frameworks for the clinical approval of AI tools remain underdeveloped, creating uncertainty around their legal status and liability in clinical practice.[15]

6. Future Perspectives

As artificial intelligence (AI) continues to evolve, its integration into oral pathology will shape the next generation of diagnostic and prognostic models. The future lies not only in technological innovation but also in addressing current barriers and ensuring equitable, ethical, and effective use.

6.1. Integration of AI with precision medicine

The convergence of AI with precision medicine represents one of the most exciting future directions. By combining histopathology with genomics, proteomics, and metabolomics, AI systems can create patient-specific molecular signatures that guide individualized treatment plans.[19] This multimodal integration will help identify biomarkers of therapeutic response, enabling clinicians to move beyond one-size-fits-all approaches toward truly personalized oncology.

6.2. Explainable AI (XAI) for interpretability

One of the biggest hurdles in current AI models is their "black box" nature. Explainable AI (XAI) aims to improve transparency by showing how algorithms arrive at specific predictions.[7] For oral pathology, XAI tools can highlight histological regions or molecular features that influenced a decision, making the results more interpretable for pathologists and more acceptable for regulatory approval.

6.3. AI-assisted training and education

Beyond diagnostics, future AI platforms will be essential for skill development and education. AI-integrated virtual reality (VR) and augmented reality (AR) systems could replicate dynamic histological learning settings, giving trainees and students access to massive datasets and real-time feedback.[11] This could help standardize training across institutions and reduce global disparities in pathology education.

6.4. Pathologist–AI collaboration: Hybrid diagnostic models

The future of oral pathology is unlikely to be AI-driven alone but rather characterized by human–AI synergy. Hybrid diagnostic models will allow AI to manage high-volume routine tasks, while expert pathologists focus on complex or ambiguous cases.[9] This collaborative workflow not only improves efficiency but also ensures that human expertise remains central in clinical decision-making.

6.5. Generative AI and foundation models

An emerging frontier is the application of generative AI and foundation models to pathology. These models, pre-trained on massive datasets, can adapt to specific diagnostic tasks with minimal retraining.[15] In oral pathology, foundation models could be fine-tuned for lesion classification, biomarker prediction, or even the generation of synthetic training datasets, reducing the dependence on manually annotated data.

7. Conclusion

In oral pathology, artificial intelligence (AI) is becoming a disruptive force that is changing the way diseases are identified, categorized, and treated. By leveraging deep learning, digital pathology, radiology, cytology, and molecular data, AI enhances accuracy, efficiency, and reproducibility while enabling earlier detection and better prognostication. Despite these advantages, challenges such as dataset bias, infrastructure limitations, ethical concerns, and regulatory uncertainty remain major barriers to clinical integration. Addressing these issues through multi-institutional collaborations, standardized digital pathology frameworks, and transparent AI models will be critical to achieving reliable implementation. Importantly, the future of oral pathology lies not in AI replacing pathologists but in fostering human–AI collaboration. Hybrid diagnostic models, where AI handles routine high-volume tasks and pathologists focus on complex interpretation, promise the best of both worlds.

Furthermore, innovations in explainable AI (XAI), precision medicine integration, and generative foundation models hold the potential to push oral pathology into a new era of personalized, predictive, and participatory healthcare. In conclusion, while AI is not without limitations, it is undeniably paving the way for next-generation oral pathology, transforming diagnostics into a more precise, efficient, and globally accessible discipline. The future will be shaped by human–AI synergy, where technology augments, rather than replaces, the expertise of oral pathologists.

8. Source of Funding

None.

9. Conflict of Interest

None.

References

1. Jiang Y, Yang M, Wang S, Li X, Sun Y. Emerging role of deep learning-based artificial intelligence in tumor pathology. *Cancer Commun (Lond)*. 2020; 40(4):154–66. https://doi.org/10.1002/cac2.12012.
2. Gharat MG, Deshpande SM, Dhone S, Mhatre VS, Sangala BN, Sethumadhavan J, et al. Digital pathology: Revolutionizing oral and maxillofacial diagnostics. *Bioinformation*. 2024; 20(12):1834–40. https://doi.org/10.6026/9732063002001834.
3. Mallineni SK, Sethi M, Punugoti D, Kotha SB, Alkhayal Z, Mubaraki S, et al. Artificial Intelligence in Dentistry: A Descriptive Review. *Bioengineering (Basel)*. 2024;11(12):1267. https://doi.org/10.3390/bioengineering11121267.
4. Prabhu VD, Saidath K, Suvarna N, Mohtesham I, Shenoy S, Prabhu RV. Artificial Intelligence and Dentistry: The Future. *J Pharm Bioallied Sci*. 2024;16(Suppl 5):S4257–61. https://doi.org/10.4103/jpbs.jpbs_1341_24.
5. Alsanie IS, Qannam A, Bello IO, Khurram SA. Exploring the role of artificial intelligence in oral pathology: diagnostic and prognostic implications. *J Oral Pathol Med*. 2025;54(7):487–97. https://doi.org/10.1111/jop.70002.
6. Sagare SV, Kumar P, Nayak R, Arya A, Patil A, Kaur M, Kaur G. An interdisciplinary role of artificial intelligence (AI) in dentistry: A focus on endodontics, oral pathology, prosthodontics, orthodontics, and periodontics. *J Pharm Bioallied Sci*. 2025;17(Suppl 2):S1811–13. https://doi.org/10.4103/jpbs.jpbs_445_25.
7. Kim I, Kang K, Song Y, Kim TJ. Application of artificial intelligence in pathology: Trends and challenges. *Diagnostics (Basel).* 2022;12(11):2794. https://doi.org/10.3390/diagnostics12112794.
8. Tiwari A, Ghosh A, Agrawal PK, Reddy A, Singla D, Mehta DN, et al. Artificial intelligence in oral health surveillance among under-served communities. *Bioinformation*. 2023;19(13):1329–35. https://doi.org/10.6026/973206300191329.
9. Aung YYM, Wong DCS, Ting DSW. The promise of artificial intelligence: a review of the opportunities and challenges of artificial intelligence in healthcare. *Br Med Bull*. 2021;139(1):4-15. https://doi.org/10.1093/bmb/ldab016.
10. Xu Z, Lin A, Han X. Current AI applications and challenges in oral pathology. *Oral (Basel).* 2025;5(1):2. https://doi.org/10.3390/oral5010002.
11. Yilmaz BE, Gokkurt Yilmaz BN, Ozbey F. Artificial intelligence performance in answering multiple-choice oral pathology questions: a comparative analysis. BMC Oral Health. 2025;25(1):573. https://doi.org/10.1186/s12903-025-05926-2.
12. Singhal I, Kaur G, Neefs D, Pathak A. A literature review of the future of oral medicine and radiology, oral pathology, and oral surgery in the hands of technology. *Cureus*. 2023;15(9):e45804. https://doi.org/10.7759/cureus.45804.
13. Krishna AB, Tanveer A, Bhagirath PV, Gannepalli A. Role of artificial intelligence in diagnostic oral pathology – A modern approach. *J Oral Maxillofac Pathol*. 2020;24(1):152–6. https://doi.org/10.4103/jomfp.JOMFP_215_19.
14. Sajithkumar A, Thomas J, Saji AM, Ali F, Haneena Hasin EK, Adampulan HAG, Sarathchand S. Artificial intelligence in pathology: current applications, limitations, and future directions. *Ir J Med Sci*. 2024;193(2):1117–21. https://doi.org/10.1007/s11845-023-03479-3.
15. Waqas A, Bui MM, Glassy EF, El Naqa I, Borkowski P, Borkowski AA, Rasool G. Revolutionizing digital pathology with the power of generative artificial intelligence and foundation models. *Lab Invest*. 2023;103(11):100255. https://doi.org/10.1016/j.labinv.2023.100255.

16. Ding H, Wu J, Zhao W, Matinlinna JP, Burrow MF, Tsoi JKH. Artificial intelligence in dentistry: A review. *Front Dent Med.* 2023;4:1085251. https://doi.org/10.3389/fdmed.2023.1085251
17. Jariyapan P, Pora W, Kasamsumran N, Lekawanvijit S. Digital pathology and artificial intelligence in diagnostic pathology. *Malays J Pathol*. 2025; 47(1):3–12.
18. Mohammad-Rahimi H, Khoury ZH, Alamdari MI, Rokhshad R, Motie P, Parsa A, et al. Performance of AI chatbots on controversial topics in oral medicine, pathology, and radiology. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2024;137(5):508–14. https://doi.org/10.1016/j.oooo.2024.01.015.
19. Gupta A, Bajaj S, Nema P, Purohit A, Kashaw V, Soni V, et al. Potential of AI and ML in oncology research including diagnosis, treatment and future directions: A comprehensive prospective. *Comput Biol Med*. 2025;189:109918. https://doi.org/10.1016/j.compbiomed.2025.109918.

Cite this article: Ojha A, Sharma D, Singh A, George J. Revolutionizing oral pathology with artificial intelligence: The next diagnostic frontier. *J Pierre Fauchard Acad*. 2025;39(3):60-66.