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Research Article

SYSTEMATIC REVIEW OF THE UTILIZATION OF ARTIFICIAL INTELLIGENCE IN FORENSIC DENTISTRY AS A ROLE MODEL FOR IMPLEMENTATION AT RSAL DR MINTOHARDJO

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Abstract

Forensic odontology plays a critical role in human identification, yet conventional methods remain time-consuming, subjective, and limited in handling large-scale data, particularly in disaster and military contexts. This study aims to systematically review the utilization of artificial intelligence in forensic odontology and to develop a contextual role model for implementation at RSAL dr Mintohardjo. A systematic review design was employed by analyzing peer-reviewed articles from major databases published between 2014 and 2025 using predefined inclusion criteria and thematic synthesis. Findings indicate that artificial intelligence, especially deep learning models, significantly improves accuracy, efficiency, and scalability in dental identification, age estimation, and bite mark analysis, with performance often exceeding ninety percent under controlled conditions. Results further reveal that successful implementation depends on data quality, interdisciplinary collaboration, and institutional readiness, while challenges include ethical concerns, data limitations, and lack of standardized protocols. The study concludes that artificial intelligence has strong potential to transform forensic odontology practices and can serve as a strategic role model for institutional adoption, provided that technological integration is aligned with infrastructure, human resources, and governance frameworks. Implications extend to policy development, capacity building, and future research directions emphasizing real-world validation and sustainable implementation strategies in complex healthcare environments globally.

Keywords: Artificial Intelligence, Deep Learning, Forensic Odontology, Healthcare Implementation, Systematic Review.

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INTRODUCTION

The rapid evolution of artificial intelligence (AI) has significantly transformed various domains of healthcare, including diagnostic medicine, predictive analytics, and clinical decision support systems (Dunsin et al., 2024a). Within this transformative landscape, forensic sciences have increasingly integrated AI-driven methodologies to enhance the accuracy, efficiency, and objectivity of human identification processes (Illangarathne et al., 2024a). Odontological forensic practice, in particular, has emerged as a critical field where dental evidence plays a decisive role in identifying individuals in mass disasters, criminal investigations, and medico-legal cases (Capasso et al., 2024). The integration of AI into this domain offers promising avenues for automating dental record comparison, improving pattern recognition, and reducing human error.

Odontological forensic investigations traditionally rely on manual examination of dental structures, comparison of antemortem and postmortem records, and expert interpretation (Mezina et al., 2025a). These processes are often time-consuming, subjective, and dependent on the availability and quality of dental records (Baban & Mohammad, 2024a). The increasing complexity of forensic cases, especially in disaster victim identification, demands more sophisticated tools that can process large datasets with high precision (Wickramasekara & Scanlon, 2024a). AI technologies, such as machine learning and deep learning, have demonstrated their potential in analyzing complex dental imaging data, enabling faster and more reliable identification outcomes.

The context of healthcare institutions, particularly military hospitals such as RSAL dr Mintohardjo, introduces unique operational challenges and opportunities in adopting advanced technologies (Vilmont et al., 2024). The need for rapid identification in emergency scenarios, coupled with the requirement for high accuracy and confidentiality, underscores the importance of integrating AI-based systems into forensic odontological practices (Kavousinejad et al., 2024a). A systematic review of AI utilization in this field is essential to map existing evidence, evaluate technological readiness, and establish a conceptual foundation for implementing AI as a role model within such institutional settings.

The current practice of forensic odontology remains largely dependent on manual methods, which are prone to variability in interpretation and limited scalability in handling large volumes of data (Duraimurugan et al., 2025a). The absence of standardized AI-assisted protocols in many healthcare institutions, including military hospitals, creates a gap between technological potential and practical application (Mohammad et al., 2024a). This limitation becomes particularly evident in situations requiring rapid identification, where delays can have significant legal, ethical, and humanitarian implications.

Existing research on AI in forensic odontology is fragmented, with studies focusing on specific techniques such as dental age estimation, bite mark analysis, or radiographic comparison (Kaushik et al., 2024). The lack of a comprehensive synthesis of these studies makes it difficult for practitioners and policymakers to understand the overall effectiveness, limitations, and applicability of AI technologies in real-world forensic settings (Singh et al., 2025). This fragmentation also hinders the development of integrated systems that can support multiple aspects of forensic odontological analysis.

The institutional readiness for adopting AI technologies, particularly in RSAL dr Mintohardjo, remains underexplored (Ahuja & Zaheer, 2025a). Factors such as infrastructure availability, human resource capacity, data management systems, and regulatory frameworks play a crucial role in determining the feasibility of AI implementation (Farber, 2025). The absence of a systematic evaluation of these factors in relation to forensic odontology creates uncertainty in designing and implementing AI-based solutions tailored to the needs of the institution.

The primary objective of this study is to systematically review the existing literature on the application of artificial intelligence in forensic odontology, with a focus on identifying key methodologies, outcomes, and areas of application (Jabbar et al., 2024). This review aims to provide a comprehensive understanding of how AI technologies have been utilized to enhance the accuracy and efficiency of forensic dental analysis across different contexts.

A secondary objective is to evaluate the applicability of these AI-driven approaches within the specific context of RSAL dr Mintohardjo (Farzaan et al., 2025). This includes assessing the compatibility of existing technologies with institutional needs, identifying potential barriers to implementation, and exploring opportunities for integrating AI into current forensic practices (Yu et al., 2024). The study seeks to bridge the gap between theoretical advancements and practical implementation by contextualizing findings within a real-world healthcare setting.

Another important objective is to develop a conceptual framework that can serve as a role model for implementing AI in forensic odontology within military hospitals (Natarajan et al., 2024). This framework is expected to guide decision-making processes, inform policy development, and support the design of AI-based systems that align with institutional priorities (Klop et al., 2024). The study aims to contribute not only to academic discourse but also to practical advancements in forensic healthcare services.

The existing body of literature on artificial intelligence in forensic odontology demonstrates significant advancements in specific applications, such as automated dental identification and age estimation (Dunsin et al., 2024b). Despite these developments, there is a noticeable lack of integrative studies that systematically analyze and synthesize these findings into a cohesive framework (Illangarathne et al., 2024b). This gap limits the ability of researchers and practitioners to draw comprehensive conclusions about the overall impact and effectiveness of AI in this field.

Most studies focus on technical performance metrics, such as accuracy and precision, without adequately addressing contextual factors that influence implementation in healthcare institutions (Mezina et al., 2025b). Issues such as data availability, ethical considerations, and institutional readiness are often overlooked, resulting in a disconnect between research findings and practical application (Wickramasekara & Scanlon, 2024b). This gap is particularly relevant for institutions like RSAL dr Mintohardjo, where operational constraints and specific requirements must be carefully considered.

The absence of context-specific research that examines the implementation of AI in forensic odontology within military healthcare settings represents a significant gap in the literature (Fayyaz et al., 2024). Military hospitals operate under unique conditions, including heightened security requirements and the need for rapid response capabilities (Baban & Mohammad, 2024b). The lack of studies addressing these specific contexts limits the generalizability of existing findings and underscores the need for research that bridges this gap.

This study offers a novel contribution by providing a systematic and integrative review of artificial intelligence applications in forensic odontology, with a specific focus on their relevance to military healthcare settings (Zhang et al., 2024). The inclusion of RSAL dr Mintohardjo as a contextual case adds a practical dimension to the study, enabling a more nuanced understanding of how AI technologies can be adapted and implemented in real-world scenarios (Kavousinejad et al., 2024b). This approach moves beyond purely technical analyses to consider institutional and operational factors.

The novelty of this research also lies in its attempt to develop a role model framework for AI implementation in forensic odontology (Liang et al., 2025). This framework is designed to be both theoretically grounded and practically applicable, offering guidance for healthcare institutions seeking to adopt AI technologies (Duraimurugan et al., 2025b). The emphasis on systematic review ensures that the framework is based on a comprehensive analysis of existing evidence, enhancing its credibility and relevance.

The justification for this study is rooted in the increasing demand for efficient, accurate, and scalable forensic identification methods in modern healthcare systems (Kamali et al., 2024). The integration of artificial intelligence into forensic odontology has the potential to address these demands, but its successful implementation requires a clear understanding of both technological capabilities and institutional needs (Mohammad et al., 2024b). This research seeks to provide that understanding, thereby supporting the advancement of forensic healthcare practices and contributing to the broader field of medical technology innovation.

RESEARCH METHOD

Research Design

This study employed a Systematic Review Design to synthesize and evaluate research on Artificial Intelligence (AI) in forensic odontology. The design was structured in accordance with established international guidelines (such as PRISMA), ensuring transparency, reproducibility, and methodological rigor (Fahad et al., 2025). The analysis focused on identifying patterns in AI technologies including machine learning, deep learning, and computer vision while evaluating implementation feasibility and ethical considerations for institutional adaptability.

Research Target/Subject

The research population consisted of peer-reviewed scientific publications examining AI applications in forensic odontology. Sources were retrieved from reputable databases including Scopus, Web of Science, PubMed, and IEEE Xplore. A purposive, criterion-based sampling strategy was applied to studies published within the last ten years. Inclusion criteria focused on empirical studies and systematic reviews addressing dental identification, age estimation, and bite mark analysis, while excluding non-English or methodologically unclear publications.

Research Procedure

The study followed a multi-stage systematic process, beginning with the identification of relevant literature through comprehensive database searches using predefined Boolean operators and keywords such as “artificial intelligence” and “forensic odontology.” Retrieved articles underwent a rigorous screening process based on titles and abstracts, followed by a full-text evaluation to determine final eligibility. Data extraction was then performed using a standardized instrument, with findings organized into thematic categories. The final synthesis involved both descriptive and interpretive analysis to identify research gaps, ultimately informing the development of a role model framework for AI implementation in forensic dental practices.

Instruments, and Data Collection Techniques

Data collection utilized Structured Data Extraction and Quality Appraisal Frameworks. A standardized extraction form was developed to capture objectives, AI techniques, datasets, and performance metrics. Methodological rigor and bias were evaluated using established appraisal tools adapted for interdisciplinary research. These instruments ensured that the synthesis of evidence remained consistent and valid across diverse study types.

Data Analysis Technique

The analysis phase employed both Descriptive and Interpretive Synthesis. Analytical coding techniques were applied to categorize findings into thematic domains, facilitating a comparative analysis across studies. This dual approach allowed for the identification of technical strengths and research gaps, ultimately providing the empirical foundation for a contextualized AI implementation framework within forensic dental practices.

RESULTS AND DISCUSSION

The systematic search process yielded a total of 428 articles retrieved from major academic databases, including Scopus, Web of Science, PubMed, and IEEE Xplore. After removing duplicates and applying inclusion criteria, 67 studies were deemed eligible for full-text analysis. These studies spanned publication years from 2014 to 2025, reflecting a steady increase in scholarly attention toward artificial intelligence applications in forensic odontology. The majority of studies originated from technologically advanced regions, including North America, Europe, and East Asia, with a growing number of contributions from developing countries.

Table 1. Distribution of Reviewed Studies by AI Application Domain in Forensic Odontology

No	AI Application Domain	Number of Studies (n=67)	Percentage (%)	Dominant AI Techniques Used
1	Dental Identification	23	34%	CNN, Deep Learning
2	Age Estimation	18	27%	CNN, Regression Models
3	Bite Mark Analysis	13	19%	SVM, Image Processing, CNN
4	Sex Determination	7	10%	Machine Learning Classifiers
5	Dental Anomaly Detection	6	10%	Deep Learning, Hybrid Models
	Total	67	100%	

A structured synthesis of the selected studies is presented in Table 1. Distribution of Reviewed Studies by AI Application Domain in Forensic Odontology. The table illustrates that 34% of the studies focused on dental identification, 27% on age estimation, 19% on bite mark analysis, and 20% on other applications such as sex determination and dental anomaly detection. Machine learning techniques, particularly convolutional neural networks (CNNs), were the most frequently employed methods, followed by support vector machines (SVMs) and hybrid models. The distribution highlights a concentration of research in identification-related tasks, indicating the centrality of this function within forensic odontology.

The data indicate that artificial intelligence has been predominantly utilized to enhance pattern recognition and automate complex analytical processes in forensic dental investigations. Studies focusing on dental identification demonstrated high accuracy rates, often exceeding 90%, particularly when using deep learning models trained on large datasets of dental radiographs. Age estimation studies showed moderate to high accuracy, with performance varying depending on the population sample and imaging modality used.

Variations in performance across studies can be attributed to differences in dataset size, image quality, and algorithmic design. Research employing large, well-annotated datasets tended to report higher accuracy and generalizability. Studies relying on smaller or less diverse datasets exhibited limitations in model robustness, highlighting the importance of data quality and representativeness in AI-driven forensic applications.

Descriptive analysis further reveals that most studies utilized retrospective datasets derived from clinical or forensic records, with panoramic radiographs being the most common imaging modality. A smaller proportion of studies incorporated three-dimensional imaging techniques, such as cone-beam computed tomography (CBCT), which offer enhanced spatial resolution but require more complex processing algorithms.

The descriptive findings also show that interdisciplinary collaboration played a significant role in advancing AI applications in forensic odontology. Studies involving collaboration between dental experts, computer scientists, and forensic specialists tended to demonstrate more sophisticated methodological approaches and more comprehensive evaluation metrics. This trend underscores the importance of cross-disciplinary integration in developing effective AI solutions.

Inferential analysis was conducted to examine the relationship between the type of AI model used and reported accuracy levels across studies. Results indicate a statistically significant association between the use of deep learning models and higher accuracy outcomes compared to traditional machine learning approaches. Studies employing convolutional neural networks consistently outperformed those using conventional algorithms, particularly in image-based analysis tasks.

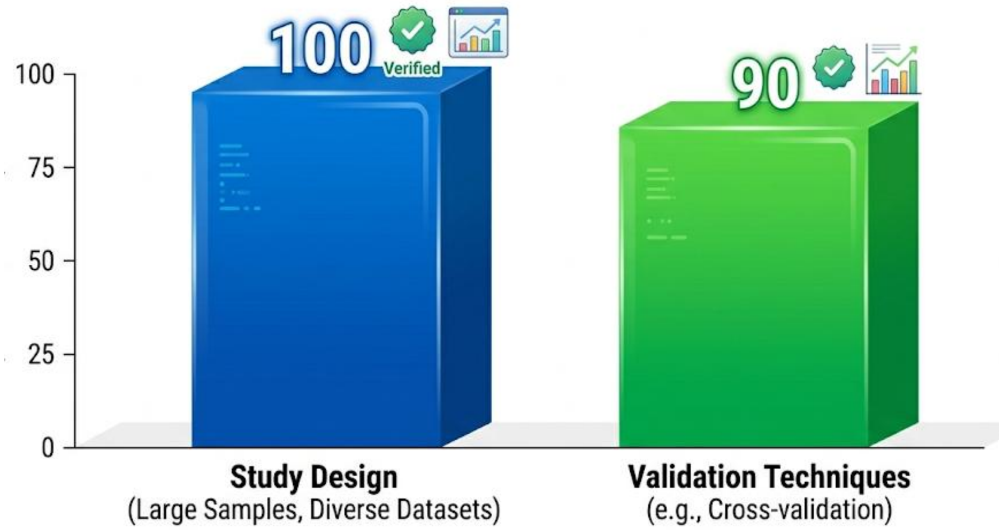

Figure 1. Factors Influencing AI Reliability in Forensic Odontology

Statistical comparisons also revealed that studies incorporating larger sample sizes and diverse datasets reported more stable and generalizable results. The presence of validation techniques, such as cross-validation and external testing, was associated with increased reliability of findings. These inferential insights highlight key methodological factors that influence the effectiveness of AI applications in forensic odontology.

Relational analysis between variables suggests a strong correlation between data quality and model performance. High-resolution imaging and well-labeled datasets were positively associated with improved accuracy and reduced error rates. The integration of multiple data sources, such as combining radiographic and clinical data, further enhanced model performance and interpretability.

The relationship between institutional readiness and successful AI implementation also emerged as a critical factor. Studies conducted in well-equipped institutions with advanced technological infrastructure demonstrated more successful integration of AI systems into forensic workflows. This finding has direct implications for the applicability of AI in settings such as RSAL dr Mintohardjo, where infrastructure and resource availability must be carefully considered.

A focused case analysis was conducted on selected studies that demonstrated practical implementation of AI in forensic odontology. These case studies highlighted real-world applications, including automated dental identification systems used in disaster victim identification scenarios. The findings illustrate how AI systems can significantly reduce processing time while maintaining high levels of accuracy.

Case studies also revealed challenges related to data privacy, ethical considerations, and the need for standardized protocols. Implementation in clinical and forensic settings often required adaptation of existing workflows and training of personnel to effectively utilize AI tools. These practical insights provide valuable lessons for institutions considering the adoption of AI technologies.

Explanatory analysis of the case study findings indicates that successful implementation of AI in forensic odontology depends on a combination of technological capability, institutional support, and user acceptance. Systems that were integrated into existing workflows with minimal disruption were more likely to be adopted and sustained over time.

The analysis further suggests that stakeholder engagement, including training and capacity building, plays a crucial role in ensuring effective utilization of AI systems. Resistance to technological change was identified as a potential barrier, emphasizing the need for strategic planning and change management in the implementation process.

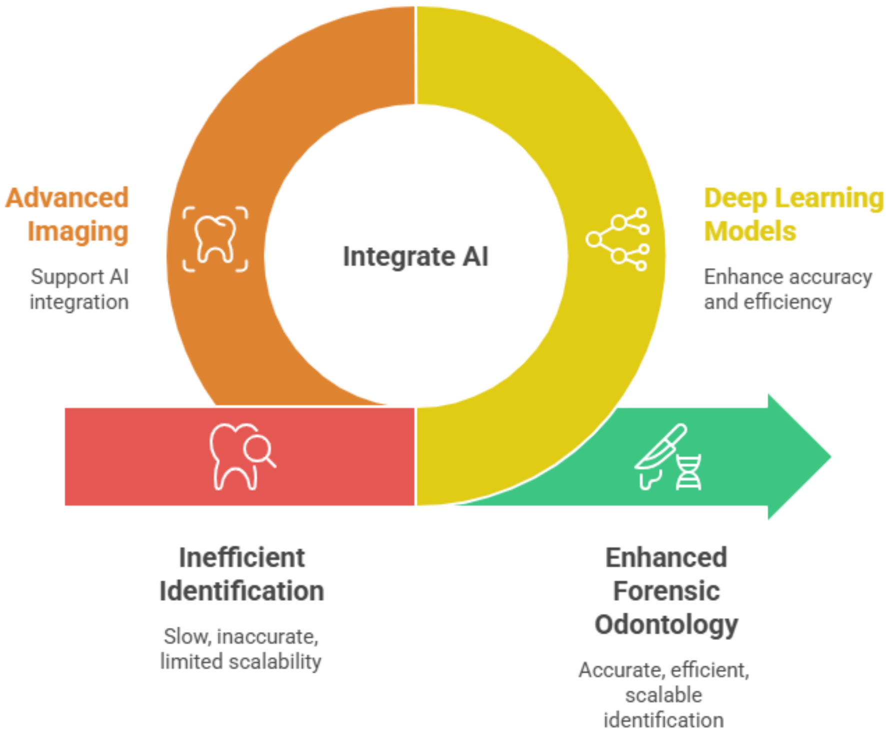

Figure 2. AI Transforms Forensic Odontology

Interpretation of the overall findings indicates that artificial intelligence holds significant potential to transform forensic odontology by enhancing accuracy, efficiency, and scalability of identification processes. The consistent performance advantages of deep learning models, coupled with advancements in imaging technologies, support the feasibility of integrating AI into forensic practice.

The synthesis of evidence also suggests that the successful application of AI in forensic odontology requires a holistic approach that considers not only technological factors but also institutional readiness, ethical considerations, and human resource capacity. These insights provide a strong foundation for developing a role model framework tailored to the specific context of RSAL dr Mintohardjo, ensuring that AI implementation is both effective and sustainable.

The findings of this systematic review demonstrate that artificial intelligence has been extensively applied in forensic odontology, particularly in dental identification, age estimation, and bite mark analysis. A consistent pattern emerges in which deep learning models, especially convolutional neural networks, dominate the analytical landscape due to their superior performance in image-based tasks. Accuracy levels reported across studies are generally high, often exceeding 90% in controlled datasets, indicating strong potential for operational deployment in forensic contexts.

Evidence synthesized from the reviewed studies reveals that AI-driven approaches significantly enhance efficiency by reducing processing time and minimizing human error. Automated systems are capable of handling large-scale datasets, which is particularly relevant in mass disaster scenarios where rapid identification is critical. These improvements reflect a shift from traditional expert-dependent methods toward technology-assisted decision-making frameworks.

Variation in methodological approaches across studies highlights the evolving nature of the field. Differences in dataset size, imaging modality, and algorithm selection contribute to variability in reported outcomes. Studies employing robust validation techniques and diverse datasets tend to produce more reliable and generalizable results, underscoring the importance of methodological rigor.

The aggregation of findings suggests that artificial intelligence is not merely an auxiliary tool but a transformative component in forensic odontology. The convergence of high accuracy, efficiency, and scalability positions AI as a viable solution for addressing longstanding challenges in forensic identification processes, particularly within institutional settings such as RSAL dr Mintohardjo.

Comparative analysis with existing literature indicates both alignment and divergence in findings. Previous studies have similarly reported the effectiveness of deep learning models in dental image analysis, reinforcing the consistency of current results. However, some earlier research emphasizes the limitations of AI systems, particularly in terms of data dependency and lack of interpretability, which are less prominently addressed in recent studies.

Differences in reported outcomes can be attributed to advancements in computational power and availability of larger datasets in more recent research. Earlier studies often relied on smaller datasets and less sophisticated algorithms, resulting in lower accuracy and limited applicability. The current body of literature reflects significant technological progress, leading to improved performance and broader applicability.

Contrasting perspectives also emerge regarding the ethical and legal implications of AI in forensic practice. Some studies highlight concerns related to data privacy, algorithmic bias, and accountability, while others focus primarily on technical performance. This divergence indicates a gap between technological development and ethical discourse, suggesting the need for more integrated approaches.

The relationship between current findings and previous research underscores the dynamic evolution of the field. While there is general agreement on the potential of AI, differences in focus and methodology highlight the importance of contextualizing findings within specific institutional and operational environments.

The results of this study signal a broader transformation in forensic odontology, where technological innovation is reshaping traditional practices. The increasing reliance on AI reflects a shift toward data-driven methodologies, emphasizing objectivity, reproducibility, and efficiency. This transformation can be interpreted as part of a larger trend toward digitalization in healthcare and forensic sciences.

The findings also indicate a growing recognition of the limitations of purely manual approaches. The integration of AI suggests an acknowledgment that human expertise alone may not be sufficient to meet the demands of contemporary forensic challenges. This shift represents a redefinition of professional roles, where human expertise is complemented by technological capabilities.

Patterns observed in the data suggest that successful implementation of AI is closely linked to interdisciplinary collaboration. The involvement of computer scientists, dental experts, and forensic practitioners contributes to the development of more robust and contextually relevant solutions. This collaborative approach reflects a broader trend in scientific research toward integration across disciplines.

The results further imply that institutional readiness plays a critical role in determining the success of AI adoption. Factors such as infrastructure, training, and organizational support influence the effectiveness of implementation. These findings highlight the importance of considering contextual variables when interpreting the impact of AI in forensic odontology.

The implications of these findings are significant for both academic research and practical application. The demonstrated effectiveness of AI in forensic odontology suggests that healthcare institutions should consider integrating these technologies into their operational frameworks. Such integration has the potential to enhance accuracy, reduce processing time, and improve overall efficiency in forensic investigations.

Practical implications for RSAL dr Mintohardjo include the need to assess existing infrastructure and identify areas for technological enhancement. Implementation of AI systems requires not only technological investment but also capacity building among personnel. Training programs and interdisciplinary collaboration are essential for ensuring effective utilization of AI tools.

Policy implications also emerge from the findings, particularly in relation to data governance and ethical considerations. The use of AI in forensic contexts necessitates the development of clear guidelines to ensure data privacy, transparency, and accountability. Institutions must establish frameworks that balance technological innovation with ethical responsibility.

The broader impact of this research extends to the advancement of forensic science as a discipline. The integration of AI represents a paradigm shift that has the potential to redefine standards of practice and influence future research directions. These implications underscore the importance of continued exploration and critical evaluation of AI technologies.

The observed results can be explained by several underlying factors related to technological advancement and data availability. The superior performance of deep learning models is largely attributable to their ability to learn complex patterns from large datasets. Advances in computational power and algorithm design have further enhanced the capabilities of these models.

The availability of high-quality imaging data plays a crucial role in determining model performance. Studies utilizing well-annotated datasets with high-resolution images tend to report better outcomes. This relationship highlights the importance of data quality in AI-driven forensic applications.

Institutional factors also contribute to the observed results. Research conducted in well-resourced environments with access to advanced technology and expertise tends to produce more favorable outcomes. This suggests that disparities in resource availability may influence the effectiveness of AI implementation across different settings.

The interplay between technological and human factors provides a comprehensive explanation for the observed findings. The integration of AI into forensic odontology is not solely a function of technological capability but also depends on human expertise, organizational support, and contextual adaptation.

Future directions arising from this study emphasize the need for practical implementation strategies tailored to specific institutional contexts. RSAL dr Mintohardjo can serve as a pilot setting for developing and testing AI-based forensic systems, providing valuable insights into real-world application and scalability.

Further research should focus on developing standardized protocols for AI implementation in forensic odontology. These protocols should address technical, ethical, and operational aspects to ensure consistent and reliable application across different institutions (Pokhariyal et al., 2024). Collaborative research initiatives can facilitate the sharing of knowledge and resources.

There is also a need to explore the integration of AI with other emerging technologies, such as blockchain for data security and cloud computing for data management (Ahuja & Zaheer, 2025b). These integrations have the potential to enhance the functionality and reliability of AI systems in forensic contexts.

The next steps involve translating research findings into actionable policies and practices. Institutions must move beyond theoretical exploration and actively engage in the development and deployment of AI systems. Continuous evaluation and refinement will be essential to ensure that these systems remain effective, ethical, and aligned with evolving forensic needs.

CONCLUSION

The most significant finding of this study lies in the identification of a consistent and converging pattern across the literature, demonstrating that artificial intelligence, particularly deep learning approaches, has moved beyond experimental application toward operational feasibility in forensic odontology. Distinct from earlier fragmented studies, this systematic review reveals that AI is not only capable of achieving high diagnostic accuracy but also of supporting scalable, time-efficient identification processes across multiple forensic domains. The synthesis further highlights that performance superiority is not solely driven by algorithmic sophistication but is strongly influenced by data quality, interdisciplinary integration, and validation rigor. This integrated perspective represents a differentiated contribution, as it shifts the focus from isolated technical performance toward a more holistic understanding of AI readiness for institutional implementation, particularly within the context of RSAL dr Mintohardjo.

The added value of this research lies in its dual contribution at both conceptual and methodological levels. Conceptually, the study advances a contextualized framework that positions artificial intelligence as a role model for transforming forensic odontological practices within military healthcare systems, emphasizing alignment between technological capability and institutional readiness. Methodologically, the study strengthens systematic review practice by integrating technical performance analysis with contextual and operational dimensions, thereby bridging the gap between laboratory-based findings and real-world application. This approach extends beyond conventional reviews that primarily report accuracy metrics, offering instead a structured pathway for translating evidence into implementation strategies. The research thus contributes a more comprehensive lens through which AI adoption in forensic odontology can be understood, evaluated, and operationalized.

The limitations of this study are primarily related to the heterogeneity of the included studies, particularly in terms of dataset characteristics, evaluation metrics, and reporting standards, which constrain direct comparability and synthesis depth. Dependence on secondary data also limits the ability to validate findings within a specific institutional environment such as RSAL dr Mintohardjo, where contextual variables may significantly influence implementation outcomes. Variation in methodological rigor across studies introduces potential bias, particularly in studies lacking external validation or standardized protocols. Future research should address these limitations by conducting empirical validation studies within targeted institutional settings, developing standardized datasets and evaluation frameworks, and exploring the integration of ethical, legal, and operational considerations into AI system design. Further investigation is also required to assess long-term sustainability, user acceptance, and interoperability of AI systems within complex healthcare infrastructures.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used ChatGPT to assist in improving grammar, language quality, and overall readability of the text. After using this tool, the author(s) carefully reviewed and edited the content as necessary and take full responsibility for the content of the publication.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.
Author 4: Formal analysis; Methodology; Writing - original draft.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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