

Artificial intelligence in forensic medicine and forensic dentistry

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ABSTRACT

This review article aims to highlight the current possibilities for applying Artificial Intelligence in modern forensic medicine and forensic dentistry and present the advantages and disadvantages of its use. For this purpose, the relevant academic literature was searched using PubMed, Web of Science and Scopus. The application of Artificial Intelligence in forensic medicine and forensic dentistry is still in its early stages. However, the possibilities are great, and the future will show what is applicable in daily practice. Artificial Intelligence will improve the accuracy and efficiency of work in forensic medicine and forensic dentistry; it can automate some tasks; and enhance the quality of evidence. Disadvantages of the application of Artificial Intelligence may be related to discrimination, transparency, accountability, privacy, security, ethics and others. Artificial Intelligence systems should be used as a support tool, not as a replacement for forensic experts.

INTRODUCTION

Artificial Intelligence increasingly permeates the lives of modern humans, and it is increasingly difficult to find areas where it is not present in at least some form. We find it in our smartphones, cars, aeroplanes, banks, healthcare, agriculture, science, entertainment, and almost everywhere; it is becoming, in some ways, frighteningly ubiquitous. All of this is not happening (at least for now) because Artificial Intelligence is so intelligent and superior, but instead because we humans are inventive, innovative, and curious, but also often lazy, too comfortable, and unwilling to look critically at the future.

The best and most recent example of this is Open AI ChatGPT. The chatbot ChatGPT (Chat Generative Pre-trained Transformer) was introduced to the public in November 2022; from then until now, its use has spread rapidly around the world, gaining several million users in just a few weeks and is considered the fastest-growing application of all time.¹ People first recognized it as a new way of entertainment. However, they quickly realized how useful it could be. They started using it increasingly as a fast and reliable assistant in doing their daily work tasks, whose shortcomings were more or less rightly neglected compared to the benefits it offers. In a very short time, it became a topic of discussion in leading scientific journals such as Nature.² There is still debate about the extent to which it may be used, for example, in writing scientific articles and whether it should be cited as an

author. Research has shown that Open AI ChatGPT can independently write a scientific summary at such a level of quality that human experts can no longer distinguish which summaries are written by humans and which by Artificial Intelligence.³

To gain a better grasp of Artificial Intelligence, it is essential to clarify the distinctions among Artificial Intelligence, deep learning, machine learning, and data science. Although these fields are interconnected, each has its own unique characteristics. Artificial Intelligence serves as the overarching domain, encompassing a wide range of techniques and methodologies designed to create intelligent machines capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and natural language processing. Within Artificial Intelligence, machine learning and deep learning operate as subsets.⁴ Data science, on the other hand, draws from all of these fields to extract insights and knowledge from data.

Artificial Intelligence branches out into various areas, including expert systems, robotics, and natural language processing. Deep learning, a subfield of Artificial Intelligence, employs neural networks inspired by the structure of the human brain to acquire knowledge from vast datasets. By automatically identifying and extracting features from raw data like images, sounds, and text, deep learning algorithms can make predictions or decisions. Notable applications of deep learning encompass image recognition, speech recognition, and natural language processing.

Machine learning, another subfield of Artificial Intelligence, concentrates on developing algorithms and statistical models that enable computers to learn from data without explicit programming. Machine learning techniques can be supervised (learning from labeled data), unsupervised (learning from unlabeled data), or semi-supervised (learning from a combination of labeled and unlabeled data). Use cases for machine learning include recommendation systems, fraud detection, and predictive modeling.

Data science, an interdisciplinary domain, merges statistical and computational techniques with specialized knowledge in various fields to extract insights and knowledge from data. It encompasses a wide array of activities, including data acquisition, cleaning and preprocessing,

exploratory data analysis, statistical modeling, and machine learning. Data science finds applications in diverse sectors such as healthcare, finance, social media, and e-commerce.

Various studies show that people's opinions about Artificial Intelligence are divided and that almost half of people fear it. In contrast, the other half enthusiastically welcome it in their daily use.⁵

Artificial Intelligence can be used in a variety of everyday applications, including:

- Personal assistants for smartphones such as Siri, Bixby, and Alexa
- Chatbots for online customer service
- Image and voice recognition in cameras and virtual assistants
- Recommendation systems in streaming services and e-commerce websites
- Fraud detection in banking and financial services
- Predictive maintenance in manufacturing and industry
- Self-driving cars and transportation
- Healthcare, e.g., medical diagnosis and personalized treatment plans
- Speech translation and natural language processing in communications.

These are just a few examples, but Artificial Intelligence has the potential to be used in many other areas as well.

The fears that Artificial Intelligence raises in people are mostly related to potential job loss, loss of privacy and lack of security, the possibility of misperceptions, lack of transparency, lack of understanding of how it works, lack of warmth and understanding that human contact provides, and numerous ethical issues that its application raises in everyday life.^{6,7}

Artificial Intelligence has long been used in various fields of medicine and dentistry. In medicine, it is used in radiology⁸⁻¹⁰, in the diagnosis and treatment of various diseases and conditions (in gastroenterology¹¹, oncology¹², cardiology¹³, dermatology¹⁴, intensive care¹⁵ and others), for new drug discovery and development¹⁶, as an aid in clinical decision-making¹⁷, in personalized medicine¹⁸, for chronic disease monitoring¹⁹, for predictive analysis²⁰, and, of course, in numerous medical researches²¹. In dentistry, Artificial Intelligence is used in numerous fields²², such as dental radiology^{23,24}, dental diagnostics²⁵, dental therapy planning²⁶, orthodontics²⁷, dental prosthodontics²⁸, periodontology²⁹, endodontics³⁰, oral pathology³¹,

dental implantology³², dental robotics³³, and other areas of dentistry³⁴⁻³⁷.

A broader practical application of Artificial Intelligence in forensic medicine and forensic dentistry has yet to emerge. This paper aims highlight the current possibilities of applying Artificial Intelligence in modern forensic medicine and forensic dentistry. For this purpose, the relevant academic literature was searched using PubMed, Web of Science and Scopus. The keywords for searching these databases were: Artificial Intelligence; Machine Learning; Forensic Medicine; Forensic Dentistry. This review paper analysed and used articles that met the stated conditions. All articles used are listed in the reference list.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN FORENSIC MEDICINE

Forensic medicine is a branch of medicine that combines medicine and law. It involves the application of medical knowledge, skills, and competencies for judicial and legal purposes, which may or may not include criminal matters. For example, forensic medicine is concerned with, among other things, the investigation of deaths (forensic thanatology), the determination of the cause of injury or death, the examination of evidence, the examination of living persons, e.g., in cases of sexual offences, the preparation of wound reports, age estimation, and the assessment of the physical and mental condition of persons involved in legal cases.

Considering that Artificial Intelligence has long been used in medicine, but also in law, where it is already widely used to find relevant documents and evidence in legal disputes, it is logical to expect its application in forensic medicine.^{38,39}

Artificial Intelligence can be used in forensic medicine and related fields in several ways⁴⁰:

- Autopsy analysis: Artificial Intelligence algorithms can be used to analyze medical images, and help identify injury patterns, diseases, postmortem interval estimation, and cause of death.⁴⁰⁻⁴⁴
- Age and sex estimation: Artificial Intelligence can be trained to assist forensic experts in age estimation based on various parameters.^{45,46}
- Facial recognition: Artificial Intelligence algorithms can be trained to recognize facial features at crime scenes and compare them to a database of known offenders.⁴⁷⁻⁵¹

- Forensic toxicology: Artificial Intelligence can analyze the sample more accurately, and the method will be less time-consuming than the traditional way of analysis and can also be combined with robotics to automate some aspects of toxicology testing.^{49,52}
- DNA analysis and "omics" data mining: omics is the suffix used in various branches of biology such as genomics, proteomics, metabolomics, toxicogenomics, etc.; Artificial Intelligence can be used for more efficient investigation of such data.^{49,53,54}
- Fingerprint analysis: Artificial Intelligence can be used to automate the process of fingerprint analysis and match fingerprints found at a crime scene with those in a database.⁵⁵
- Gunshot analysis: Artificial Intelligence algorithms can analyze audio recordings of gunshots to determine the type of firearm used and the number of shots fired.^{56,57}
- Digital forensics: Artificial Intelligence can be used to analyze digital devices and data to uncover hidden evidence and track criminal activity.^{58,59}

Overall, Artificial Intelligence can help forensic professionals work more efficiently, accurately, and objectively, leading to better investigative results.⁶⁰⁻⁶²

APPLICATION OF ARTIFICIAL INTELLIGENCE IN FORENSIC DENTISTRY

As in forensic medicine, Artificial Intelligence is increasingly used in forensic dentistry. Although this is mainly a practical application with a relatively narrow purpose, there are also examples, albeit rare, where Artificial Intelligence has become almost commonplace in the work of forensic dentists. Artificial Intelligence-based technologies used in forensic dentistry include deep neural networks, Artificial neural networks, machine learning, and computer technology.⁶³

Artificial Intelligence can be used in a variety of ways to improve forensic dentistry, including:

- Dental identification: Artificial Intelligence can assist forensic dentists in analyzing dental images, such as radiographs, in identifying and matching individuals based on their teeth and jaws.⁶⁴⁻⁶⁸
- Age and sex estimation: Artificial Intelligence can be used to analyze dental images to help forensic dentists estimate the age and sex of individuals.^{67,69}

- Facial reconstruction: Artificial Intelligence can be used to create 3D models of teeth and jaws for use in the facial reconstruction of unidentified remains.⁷⁰
- Bite mark analysis: Artificial Intelligence can be used to analyze and match bite marks that can be used as evidence in criminal cases.⁶⁷
- Dental databases: Artificial Intelligence can be used to search and match dental data in databases, which can help identify individuals.
- Chatbots: Artificial Intelligence-powered chatbots can be used to answer questions and educate people about forensic dentistry.
- Automation of tasks: Artificial Intelligence can be used to automate specific tasks such as dental image analysis, reducing the need for manual human labour and increasing the speed and accuracy of identification.⁷¹

Artificial Intelligence is a technology still evolving in forensic dentistry, and its utility depends on the particular use case and implementation. It is also essential that adequate regulations and controls are in place to ensure that AI systems are safe, effective, and ethical.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN AGE ESTIMATION

Age determination is a necessary procedure in forensic medicine and forensic dentistry. The appropriate procedure choice depends on many factors, including the material available for analysis, the time and facilities available, and, of course, the experience of the expert. No ideal, universal method for age estimation can be applied universally.

One of the goals of forensic work is to estimate the age of individuals in order to establish their biological profile, which is critical in criminal investigations and disaster scenarios because skeletal remains are often fragmented and complex to identify.⁷² Both anthropological methods and new biochemical techniques must be used to estimate age accurately. For subadult individuals, age is estimated using forensic anthropology and dentistry methods based on changes in bones and teeth caused by growth and development. In contrast, age estimation in adults is based primarily on degenerative changes in bones and teeth and is less accurate than in subadult individuals. Because age estimation becomes less accurate with age, alternative methods have been developed to estimate adult age by examining

biochemical changes resulting from the physiological ageing process. While these biochemical methods are accurate, they also have limitations. Therefore, the combined use of anthropological and biochemical methods can lead to more accurate age estimation.⁷³

An ideal age estimation method should have the following characteristics:

Accuracy, reliability, noninvasiveness, ease of use, inclusiveness, acceptability, privacy, cost-effectiveness, and speed. Accuracy: The method should provide accurate results consistent with actual age. Reliability: Results should be consistent regardless of the individual or circumstances and should not vary significantly from one measurement to the next. Non-invasive: The method should be non-invasive, i.e. nobody samples should be taken, or the person should not be exposed to harmful substances. Easy to use: The method should be easy to use, requiring minimal training and resources and no special equipment. Comprehensive: The method should be able to estimate the age of individuals from a wide range of age groups, races, and ethnicities. Acceptability: The method should be socially and culturally acceptable to the individual and should not discriminate against any particular group. Privacy: The method should protect the individual's privacy and not reveal personal information beyond age. Cost-effectiveness: The method should be cost-effective and not require a significant financial investment. Speed: The method should produce results in a reasonable amount of time without undue delay or inconvenience to the individual.⁷⁴ The methods most commonly used by forensic anthropologists to estimate age in adults are based on examination of the pubic symphysis, sternal rib end, the auricular surface of the ilium, teeth, and cranial sutures.⁷⁵ Several parameters are used in forensic dentistry for age estimation in adults. These include tooth wear, absence/presence of wisdom teeth, a fusion of cranial sutures (palatal), degeneration of jaw bones, radiographic appearance of tooth roots on radiographs, transparency of root dentin, presence of secondary dentin, etc.⁷⁶ In addition, for age estimation in subadult individuals in forensic dentistry, we can use the development and eruption of deciduous and permanent teeth and the degree of root development, including the closure of the apical foramen.⁷⁷

Artificial Intelligence can be used to estimate age by analyzing various features of a person, such as images of their face, teeth, or bones⁷⁸. The Artificial Intelligence system can be trained to recognize patterns and features associated with different ages and then use this knowledge to estimate the age of an unknown person. In dental age estimation, Artificial Intelligence can be used to analyze dental images, such as x-rays, to estimate a person's age based on the development and wear of their teeth.^{63,79-85} In skeletal age estimation, Artificial Intelligence can be used to analyze skeletal images such as X-rays or CT to estimate a person's age based on the development and degeneration of their bones.⁸⁶⁻⁸⁸ Seo et al. used a deep-focus approach for bone age estimation from lateral cephalograms. They included 900 participants aged 4 - 18 years, and the regression model for estimating bone age from segmented cervical vertebrae images yielded average mean absolute error and root mean squared error values of 0.300 and 0.390 years.⁸⁹ Artificial Intelligence can be used to estimate facial age: Artificial Intelligence can be used to analyze images of a person's face, such as photographs, to estimate their age based on the appearance of wrinkles, skin texture, and other features.⁹⁰ In addition, Artificial Intelligence can build predictive models to estimate a person's age based on various data, such as images, measurements, and demographic information. Today, several Artificial Intelligence-based algorithms have been developed to determine a person's age or skeletal remains. These algorithms typically use different types of radiographs for these purposes.^{79,91,92} Kluck et al. used Artificial Intelligence for hand and wrist skeletal age estimation. They concluded that the results of skeletal age estimation by artificial intelligence were generally more outstanding than the results of skeletal age estimation performed by humans using the Greulich and Pyle method.⁹³ Many conventional methods for determining tooth age have also been tested in the environment provided by Artificial Intelligence.^{79,94} Shen et al. tested Cameriere's method for determining tooth age on a sample of 748 children. They concluded that the accuracy of tooth age determination was higher with machine learning methods based on Cameriere's maturation stages than with Cameriere's formula. The study results suggest that machine learning algorithms may be better than the traditional Cameriere formula.⁹⁵ Third

molars are very often used for age estimation. Upalananda and Wantanajittikul developed a semi-automated technique to assess the developmental stage of mandibular third molars. The overall accuracy of this method was 82.5%, whereas the accuracy in each developmental stage ranged from 87.5% to 97.5%.⁹⁶

It is important to note that age estimation is complex, and no single method can provide an exact age. Therefore, various methods, including Artificial Intelligence, should be used to obtain the most accurate age estimate. In addition, age estimation may be more difficult in children younger than three years of age than in adults because dental and skeletal development is different in children. Artificial Intelligence can be used to automate specific tasks such as analyzing imaging and patient data, reducing the need for manual labour and increasing the speed and reliability of the process.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN SEX DETERMINATION

Sex determination is an essential aspect of forensic medicine and is performed in a variety of situations, such as criminal investigations, when determining the sex of a victim or suspect can help with identification; in the identification of victims of mass disasters; in missing person cases, when determining the sex of the remains can help with identification and provide closure for families; in genealogical research, sex determination can help confirm family relationships and establish family trees; in specific medical investigations, such as autopsies, sex determination is performed to determine the cause of death and to gather additional information about the person's anatomy and physiology. Sex determination in forensic medicine must be performed with extreme care and accuracy to ensure that the results are reliable and not influenced by bias or error. Several parameters can be used to determine the sex of a person in forensic science, depending on the state of preservation of the material being examined. If the state of preservation is good, examination of the external genitalia, such as the presence or absence of a penis and testes, can be used to determine sex. In addition, other parameters may be used. Skeletal structure: The size and shape of bones, such as the pelvis, can explain a person's sex. Cranial measurements:

Cranial measurements, such as the size of the forehead, jaw, and brow ridge, can also help determine sex. Dental characteristics: Differences in tooth size, shape, and eruption between males and females can be used. DNA analysis is a very accurate method of determining the sex of an individual. It involves analyzing the presence of the Y chromosome, which is present in males. Hormones such as testosterone and estrogen are present in different amounts in males and females and can be used to determine sex. The accuracy of sex determination can vary depending on the methods used and the individual's developmental stage. A combination of several methods is often used to increase the accuracy of the results. Sex determination in forensic dentistry in children without distinct sexual characteristics is complicated and challenging, almost impossible.

Artificial Intelligence can be used for sex determination by analyzing various features of a person, such as images of the face, teeth, or bones.^{39,69,85} Research performed by Oura et al. about deep learning in sex estimation from knee radiographs reached the highest overall testing accuracy of 90.3% in sex estimation.⁹⁷ The Artificial Intelligence system can be trained to recognize patterns and features associated with different sex and then use this knowledge to determine the sex of an unknown person. Artificial Intelligence and artificial neural networks⁹⁸ can be used to analyze dental images, such as x-rays, to determine a person's sex based on the size, shape, and development of their teeth and jaws.^{99,100} Artificial Intelligence can be used to analyze skeletal images such as X-rays or CT to determine a person's sex based on their bones' size, shape, and development.¹⁰¹ In addition, Artificial Intelligence can be used to analyze images of a person's face, such as photographs, to determine sex based on wrinkles, skin texture, and other features. Bianchi et al. developed a semi-automatic method for estimating sex based on the shape of the crown of upper posterior teeth.¹⁰²

Sometimes, Artificial Intelligence can be used to create predictive models that estimate a person's sex based on various data, such as images, measurements, and demographic information. In some instances, Artificial Intelligence can automate some tasks, such as analyzing imaging and patient data, reducing the need for manual

labour and increasing the speed and accuracy of the sex determination process.

Sex determination is a complex process, primarily using only dental material. To increase reliability and accuracy, other methods such as skeletal sexing, facial sexing, and predictive models should also be used. Artificial Intelligence-based sex determination is a technology still under development, and its accuracy may vary depending on the specific use case and the quality of the data used to train the system.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN DENTAL IDENTIFICATION

Tooth identification is important in dental identification because teeth are unique to each individual and provide a reliable way to identify a person.¹⁰³ Teeth are not only unique in size and shape, but also have specific patterns of grooves and ridges that can be used for identification.¹⁰⁴ In forensic science, dental identification can be used to identify human remains in cases where other forms of identification are not possible, such as in mass disasters or when a body is decomposed or mutilated.¹⁰⁵ Dental identification involves comparing dental records, including radiographs, dental charts, and dental models, with the body's teeth to determine a match. Dental identification is considered one of the most reliable forms of identification because teeth are often well preserved even in the presence of fire, trauma, or other destructive forces. In addition, dental records are often available and can provide quick and accurate identification. Therefore, tooth identification is an essential part of dental identification and plays a critical role in forensic science, providing evidence that can help solve crimes and assist families in missing persons cases.

There are several ways in which Artificial Intelligence can be helpful in tooth identification.⁶⁴ Identification of individual teeth on x-rays: Artificial Intelligence can independently identify specific tooth types on radiographs with a high degree of precision and reliability.¹⁰⁶⁻¹¹⁰ In addition, recently there has been an increasing amount of research indicating the possibility of Artificial Intelligence recognizing the types of dental implants on radiographs.^{111,112} Image analysis: Artificial Intelligence can help forensic dentists analyze dental images, such as x-rays, to identify and

match individuals based on their teeth and jaws.¹¹³ Dental databases: Artificial Intelligence can be used to search and match dental records in databases, which can help identify individuals. Automation: Artificial Intelligence can be used to automate certain tasks, such as dental image analysis, which can significantly reduce the need for manual labor and improve the speed and accuracy of the identification process.¹¹⁴ Predictive analytics: Artificial Intelligence can help predict the likelihood of certain dental conditions and diseases based on a patient's data, contributing to prevention and treatment. Age estimation: Artificial Intelligence can be used to analyze dental images to help forensic dentists estimate the age of individuals, which can be helpful in cases where the person's identity is unknown. Facial reconstruction: Artificial Intelligence can be used to create 3D models of teeth and jaws, which can help in facial reconstruction of unidentified remains.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN THE DETECTION OF BITE PERPETRATORS

Bite mark analysis is a forensic science concerned with examining and comparing human bite marks on the skin, food, or other objects.¹¹⁵ The goal of bite mark analysis is to determine if a particular person caused the bite mark and to provide evidence that can be used in court.¹¹⁶ The bite mark analysis typically involves taking and preserving the bite mark, examining and documenting the bite mark, comparing the bite mark to known dental impressions or records, and interpreting and analyzing the results.¹¹⁷

Artificial Intelligence can be helpful in bite mark analysis in several ways.^{118,119} Image enhancement: Artificial Intelligence can enhance images of bite marks, making it easier for forensic dentists to analyze them and identify patterns and features. Matching: Artificial Intelligence can be used to analyze and match bite marks, which can be used as evidence in criminal cases. A person can be classified as a suspect or ruled out by comparing bite marks found on a victim or object with a suspect's dental records. Automation Artificial Intelligence can automate specific tasks like analyzing dental images. This can have a positive impact on the speed and accuracy of the identification process and reduce the possibility of human error and the need for manual labour. Predictive analytics: Artificial Intelligence can

help predict the likelihood of certain dental conditions and diseases based on patient data, contributing to their prevention and treatment. Dental databases: Artificial Intelligence can be used to search and match dental records in databases, which can help identify individuals. Age estimation: Artificial Intelligence can be used to analyze dental images to help forensic dentists estimate the age of individuals in the context of bite marks, which can be helpful in cases where the individual's identity is unknown.

CONCLUSIONS

The application of Artificial Intelligence in forensic medicine and forensic dentistry is still in its early stages. However, the possibilities are tremendous, and the future will show what is applicable in daily practice.

- The use of Artificial Intelligence in forensic dentistry has several advantages: Improved accuracy and efficiency: Artificial Intelligence can help forensic dentists analyze large amounts of dental data, such as imaging and patient records, to identify and match individuals more quickly and accurately.
- Automation of tasks: Artificial Intelligence can be used to automate certain tasks, such as dental image analysis, which can reduce the need for manual labour and increase the speed and accuracy of identification.
- Improving the quality of evidence: Artificial Intelligence can be used to enhance images and better represent teeth and jaws, which can help improve the quality of evidence in forensic cases.

In addition, as mentioned earlier, Artificial Intelligence can be used to analyze dental images to assist forensic dentists in estimating the age of individuals; Artificial Intelligence can be used to create 3D models of teeth and jaws that can be used to assist in the facial reconstruction of unidentified remains; Artificial Intelligence can be used to analyze and match bite marks, which can be used as evidence in criminal cases; Artificial Intelligence can be used to assist in searching and matching dental records in databases, which can help identify individuals.

In addition to the advantages, the application of Artificial Intelligence also has some disadvantages, which may be related to discrimination, transparency, accountability, privacy, security, ethics and others. Bias and discrimination: Artificial Intelligence systems can

perpetuate and even amplify bias and discrimination in the data on which they have been trained. This can lead to misidentification or misestimation of the age and sex of individuals and even misidentification of bite marks. Lack of transparency and accountability: It can be challenging to understand how Artificial Intelligence systems make decisions, making it difficult to explain or hold them accountable. All of this makes them difficult to use as evidence in court. Privacy and security concerns: Artificial Intelligence systems require large amounts of patient data to function, which can lead to privacy and security concerns, especially given the proliferation of electronic dental records. Dependence on technology: Artificial Intelligence may become a crutch that forensic dentists rely on too heavily, to the point that some may only be able to perform tasks with the assistance of Artificial Intelligence. Currently, this problem is in its infancy, with few examples of Artificial Intelligence being used daily in the work of forensic dentists. Limited understanding: Artificial Intelligence systems may be limited in their understanding of context and may need help understanding nuances and subtleties of human oral health and disease, especially in the legal context required by forensic dentistry. Job displacement: Artificial Intelligence can automate

specific tasks, such as analysing dental imaging and patient data, leading to job displacement and unemployment. In some fields, job displacement has become a severe problem, but this is different from the work of forensic dentists. Ethical concerns: Artificial Intelligence can raise ethical concerns such as autonomy and decision-making in healthcare. Ethical issues will become more critical as the application of Artificial Intelligence becomes more prevalent in forensic medicine and forensic dentistry. Ethical issues are primarily related to the origin of the samples on which Artificial Intelligence is trained.

It is essential to consider these potential advantages and disadvantages when developing and implementing Artificial Intelligence systems in forensic medicine and forensic dentistry and to have regulations and controls in place to mitigate potential negative impacts. It is also essential to ensure that Artificial Intelligence systems are used as a support tool rather than a replacement for forensic experts.

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