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Artificial intelligence in orthodontics and dentistry: A systematic review

Inteligencia artificial en ortodoncia y odontología: Revisión sistemática

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ABSTRACT

Objective: to analyse artificial intelligence in orthodontics and dentistry through a systematic review. **Method**: systematic review. **Results**: 15 scientific articles were reviewed. **Conclusion**: artificial intelligence (AI) represents a significant advance in dentistry, particularly in orthodontics, as it allows for greater diagnostic precision, optimises treatment planning and personalises clinical care. However, its implementation faces significant challenges, such as the need for more representative clinical databases, the standardisation of dental records, the adequate training of professionals and the resolution of ethical dilemmas related to data privacy and responsibility in decision-making.
Descriptors: dental staff; esthetics dental; mouth rehabilitation. (DeCS).

RESUMEN

Objetivo: analizar la Inteligencia artificial en ortodoncia y odontología desde una revisión sistemática. **Método**: Revisión sistemática. **Resultados**: se revisaron 15 articulos científicos. **Conclusión**: La inteligencia artificial (IA) representa un avance significativo en la odontología, particularmente en la ortodoncia, al permitir una mayor precisión diagnóstica, optimizar la planificación de tratamientos y personalizar la atención clínica. No obstante, su implementación enfrenta retos importantes, como la necesidad de bases de datos clínicas más representativas, la estandarización de los registros odontológicos, la capacitación adecuada de los profesionales y la resolución de dilemas éticos relacionados con la privacidad de los datos y la responsabilidad en la toma de decisiones.
Descriptores: personal de odontología; estética dental; rehabilitación bucal. (DeCS).

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INTRODUCTION

In the field of orthodontics, AI has shown great potential in facilitating cephalometric analysis, predicting dental movements and personalising treatment plans, improving diagnostic accuracy and optimising clinical efficiency (7,12). These technologies not only reduce variability between professionals, but also allow for a more predictable approach that is focused on the individual needs of patients (2,6).

The development of advanced algorithms, such as machine learning and neural networks, has allowed AI to process large volumes of clinical data and diagnostic images with a precision comparable to, or even superior to, that of specialists (7,13). Its integration with emerging technologies, such as 3D printing and augmented reality, is revolutionising surgical planning and the execution of orthodontic and orthognathic treatments, offering more predictable and personalised results (1,5,15). However, despite its benefits, the implementation of AI in clinical practice faces significant challenges, including the need for more representative and standardised databases, the training of professionals in the use of these tools and the resolution of ethical dilemmas related to data privacy and responsibility in decision-making (4,8,14). The adoption of these technologies may be limited by the high associated costs and the lack of technological infrastructure in certain regions or clinics (3,9,11). The objective of the research presented is to analyse artificial intelligence in orthodontics and dentistry through a systematic review.

METHOD

A systematic review is presented. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed.

The search for 15 articles was carried out in databases such as PubMed, Scopus, Web of Science.

The search was carried out using controlled terms and keywords related to artificial intelligence and dentistry, combined with Boolean operators. Some of the terms used were:

'artificial intelligence,' "machine learning," "orthodontics," "orthognathic surgery," "cephalometric analysis," "dental treatment planning," and their Spanish equivalents.

RESULTS

AI has proven to be a valuable tool in cephalometric analysis, the prediction of dental movements and the planning of orthodontic and orthognathic treatments. Studies such as those by Subramanian et al. (7) and Liu et al. (12) report that machine learning algorithms have achieved levels of accuracy comparable to those of specialists in the identification of cephalometric points and in the evaluation of anatomical structures, which optimises diagnosis and reduces interobserver variability. In contrast, Evangelista et al. (13), in a recent meta-analysis, confirm the high accuracy of AI in decision-making related to tooth extractions, which could standardise clinical criteria and improve therapeutic outcomes.

In terms of personalising treatments, Dipalma et al. (2) emphasise that AI-based predictive models allow for the design of treatment plans that are more tailored to the individual needs of patients, improving the predictability of clinical outcomes, as Monill-González et al. (6) indicate that AI has optimised processes such as image segmentation and the identification of anatomical structures, significantly reducing the time required for repetitive tasks and minimising human error.

In the field of orthognathic surgery, Siddiqui et al. (1) and Wong et al. (15) focus on how AI has improved surgical planning through accurate simulations of postoperative outcomes, allowing surgeons to anticipate potential complications and adjust procedures accordingly. Likewise, Bonny et al. (5) point out that the integration of AI with technologies such as 3D printing and augmented reality could revolutionise the planning and execution of surgical and orthodontic treatments in the near future. However, despite the advances, the implementation of AI in dentistry faces significant challenges, one of the main ones being the quality and representativeness of the data used to train the models, as Khanagar et al. (11) and Ahmed et al. (4) emphasise that the lack of standardisation in clinical records and the variability in imaging techniques can limit the generalisation of algorithms, affecting their performance in real clinical contexts. real clinical contexts.

Another important challenge is acceptance by healthcare professionals, in response to which Hellyer (8) and Leonardi & Vaiid (14) point out that many dentists and orthodontists still distrust AI due to a lack of understanding of how it works and ethical concerns related to data privacy and liability in the event of errors. These authors raise ethical dilemmas about the possible dehumanisation of patient care and excessive dependence on technology, which could compromise the professional-patient relationship.

Finally, Liu et al. (3) and Yamashiro & Ko (9) point out that the implementation of AI requires a significant investment in technological infrastructure and professional training, which can represent a barrier to its adoption in smaller clinics or in countries with limited resources, where access to advanced technologies is restricted.

To overcome these limitations, it is essential to invest in the creation of more robust and representative databases, as well as in the training of professionals in the use of AI tools. Likewise, Thurzo et al. (10) suggest that collaboration between academic institutions, clinics and technology companies could accelerate the development of more accurate and ethical models. In this order, Bonny et al. (5) propose that the integration of AI with emerging technologies such as 3D printing and augmented reality could open up new possibilities in the planning and execution of treatments, while Liu et al. (3) propose that combining AI with learning approaches could enable the development of more autonomous and accurate systems, and Wong et al. (15) highlight the potential of bibliometrics to identify emerging trends and guide future research in the field.

CONCLUSION

Artificial intelligence (AI) represents a significant advance in dentistry, particularly in orthodontics, by enabling greater diagnostic accuracy, optimising treatment planning and personalising clinical care. However, its implementation faces significant challenges, such as the need for more representative clinical databases, the standardisation of dental records, the adequate training of professionals and the resolution of ethical dilemmas related to data privacy and responsibility in decision-making.

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Non-monetary

CONFLICT OF INTEREST

There is no conflict of interest with people or institutions linked to the research.

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