LETTER TO THE EDITOR

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Artificial intelligence in maxillofacial radiology: threat or tool?

Daniel Pinto Agüero[1, 2, a, b], *Martina Jácome Hidalgo*[3, a, c]

Dear Editor,

In 1975, Allen Newell and Herbert Simon, recipients of the prestigious Turing Award, formulated the physical symbol system hypothesis, which can be summarized as follows: "every physical symbol system possesses the necessary and sufficient means to carry out smart actions". Artificial intelligence (AI) is then in charge of verifying this hypothesis using digital computers.

In medical and dental science, the anticipated potential use of AI as a diagnostic tool is, with an eye to the future, limitless. Particularly in maxillofacial radiology, whose rapid progress is based precisely on the use of computers, it can even have a greater benefit, given the number of interpretative support applications, thus enhancing the diagnostic capacity of the professional specialist, improving times and increasing the assertiveness in their judgment, which will be based on easily quantifiable data.

The support provided by this technology should be wisely used and incorporated into the daily workflow of an imaging center. At the same time, it will aim to provide better health care with the legal backing of a trained and accredited professional who shall, in turn, ensure the ethical use of the database, ensuring the confidentiality of the information and, if it is centralized, the professional will be able to work together with others without any barrier of physical distance as an impediment to make dental diagnosis even more efficient and practical in order to provide a better health condition.

It is in the interest of AI to develop systems that think like "humans think" to perform tasks that we would normally do. There is no evidence that AI is (or will ever be) superior to human intelligence (1). Therefore, in the era of specificities and subspecialties, having "intelligent" imaging support in high-flow dental medical care will be a real tool to support the radiologist's overdemand and physical exhaustion. Staying away from this aid seems —*a priori*— a nonsense that should, at least, be re-evaluated by each specialist today.

[1] Universidad Finis Terrae. Santiago, Chile.
[2] Asociación Latinoamericana de Radiología e Imagenología Dentomaxilofacial. Santiago, Chile.
[3] Complejo Asistencial Dr. Sótero del Río. Santiago, Chile.
[a] Dental Surgeon.
[b] Specialist in Radiology and Oral and Maxillofacial Implantology.
[c] Master in Public Policies.

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Corresponding author:
Daniel Pinto Agüero.
Address: Facultad Odontología, Universidad Finis Terrae
California #1980.
Providencia - Santiago - Chile.
Contact: dpinto@uft.cl

In maxillofacial radiology, utilities —with different levels of efficiency, compared to the diagnostic capacity of the human being— are varied. These systems require labeled data previously fed by a human expert, a field of AI called Machine Learning (ML), in which the machine creates an algorithm by which it can classify what it sees using feature engineering. In turn, Deep Learning (DL), a subfield of ML, makes use of a convolutional neural network (CNN), by which it can automatically learn the algorithmic function from labeled data, without human intervention, learning finally by itself.

For the time being, AI can provide additional recognition capability in interproximal caries lesions or periapical pathologies through three tasks: i) "classification" to binary categorize an image between "healthy" or "caries lesion" tooth; ii) "detection", drawing a box on the image near the caries lesion boundaries; iii) and "segmentation", which results in almost perfect color delineation of the carious lesion, with precision in the pixels bordering it (2). Without going back in time, with respect to cephalometric analysis, the recognition of anatomical landmarks and the classification of skeletal relationships use since 1998 the identification of anatomical landmarks with algorithm-based methods. And in 2014, the automated identification of 3D anatomical landmarks is used, thus overcoming several shortcomings of 2D image analysis, such as projection errors, object magnification and overlapping of structures. On the other hand, in legal dentistry, advances have been demonstrated with the use of CNN to estimate age by stratifying the development of the third molar corresponding to the Demirjian classification in panoramic radiographs, whose use in forensic sciences can contribute enormously, at the time of identification, through dental organs of victims in large-scale disasters where bodies have been severely mutilated (3).

As can be seen, AI has been surreptitiously accompanying us for decades, safely supporting us in tasks that, without its help, would delay diagnosis and lengthen treatments. So why should we hesitate over the benefits of a breakthrough that has so far been an excellent ally? Our humanity lies in chemical interactions and, with the environment, it is an accumulation of things impossible to objectify, some even transient and intangible, whose existence we know and admit as ours, and in some cases they govern our lives. It is these human essences, which Gerd Leonhard calls "androrhythms" (similar to computational algorithms), that we must —as healthcare and therefore service professionals— protect, even if this makes us inefficient in comparison with non-biological systems. Technology will always be there for human beings, and not the other way around (4).

Legal and bioethical implications and limitations that AI implies are and will be constant reflections where multiple actors should be considered, so that technical and scientific advances do not affect intellectual development or the things that make us human.

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