AI in Forensic Odontology : Should we bite the apple?

Forensics is application of science to criminal and civil laws or use of scientific methods or expertise to investigate crimes or examine evidence that might be presented in a court of law. Forensic odontology has been defined as that branch of forensic medicine which in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of the dental findings. The advent of digital technologies such as computer-aided design and manufacturing systems, digital records, facial reconstruction, touch-free autopsy etc has resulted in quick identification and extraction of a large amount of data with accuracy.

The rate of research has been incredible keeping pace with the rate of crimes, disasters and the need to collect the evidence in an accurate way. There has been a growing role of artificial intelligence by the way of Convolutional Neural Networks (CNN) in the forensic anthropology, forensic radiology and forensic odontology. The use has increased manifold all over the world. The process is being hailed as a watershed moment in forensic medicine, leading to unprecedented improvement of forensic analysis. The scope of use is increasing daily in which processing and recognition using deep learning to perform generative and descriptive tasks are done. It can be used in various areas of forensic odontology likesex determination, age estimation, 3D cephalometric landmark annotation, growth vectors prediction, and facial soft-tissue estimation from the skull. The identification process is based both on is used to extract features in three dimensions where input is a 3D volume or a sequence of 2D pictures.

In producing accurate 3D models, layered convolutional neural networks are being used in which 3D U-Net architecture allows a direct segmentation of high-resolution CBCT images. This approach creates 3D mandibular models in a more time-efficient and consistent way resulting in generation of big data. The Big Data culture embraces cyber-physical systems, cloud computing, and the Internet of Things (IoT). There are basic characteristics which are present in the generation of big data .

Variability (lack of structure, consistency, and context); Variety (includes audio files, imagery, numerical data, and text data); Velocity (real-time processing and very high speed of transmission);

Veracity (accuracy, noise, and uncertainty in data) and Volume (extremely large data sets). The use of AI involves detection, discrimination and classification according to the dataset provided. For the dental matching processes, the tooth appearance, the position of each tooth using machine learning and graphical models have been calculated to get a parameter for the similarity using panoramic radiographs. The SURF (Speeded-Up Robust Features) algorithm have allowed fast and robust recognition of dental characteristics like tooth shapes and dental works i.e. fillings, inlays, onlays, crowns, dental bridges, etc. The learning software programmes that are used for neural networks include MATLAB Neural Network, Toolbox, Computer vision, Transfer learning etc. The studies have indicated that 85% to 100% accurate results with the use of AI in identification have been possible. A pitfall in accurate assessment remains faulty or absent data inputs, lack of facility with the technology and changes in decisions consequent on IT technology and automation bias may result in trivial, near-miss, or consequential harms like a false identification as compared to a missed identification.

To make use of the technology, massive public and private investment is necessary so that hospitals are equipped to develop their own algorithms which for a developing country like ours with limited resources but exponentially large potential will be a challenge but if we do not implement it in the current momentum of increasingly relevant artificial intelligence applications, our means will be too limited to meet our expectations.

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