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The future of digital twins in precision dentistry

While there has been an exponential growth of research interest in Digital Twins, inconsistencies in its definition are a growing concern across a variety of industries that question the novelty and vibrancy of a technology that has successfully existed for decades.[1] Digital Twins are virtual replicas of physical objects that dynamically converge the physical and digital worlds enabled by the increasing ability to capture large amounts of evolving data utilizing the understanding from various prediction models. It offers an advantage of understanding complex processes by dynamically adjusting the model, providing insights that stretch beyond standalone simulations.[2] Although predominantly employed by industrial and engineering sectors, Digital Twins are increasingly permeating the healthcare domains with the aim of implementing personalized clinical pathways that could innovatively manage the progression of a disease as well as the patient's response to different treatments.[3] Major breakthroughs were already seen in insulin management Digital Twin technology and the generation of a Cardiac Digital Twin to improve diagnosis, prognosis, and therapies.[4,5] Constructing Digital Twins of the human immune system is also within reach and may allow us to accurately diagnose patients before the onset of any symptoms.[6] Digital Twin applications are particularly relevant to complex and multidimensional biological systems that require dynamic model updating to analyze and make predictions on big data, a revolutionizing concept that extends to dental digitalization. These multi-scale revolutions have the potential to tailor drug characteristics as well as implant and prosthetic geometries to ultimately build the Digital Twin of a patient, increasing the capacity to improve prognosis towards this vision of precision dentistry.[1] The first such attempt of Digital Twins in dentistry was made in the 3D analysis of facial profiles to compare the sagittal relationship between the maxillary central incisors and the forehead before and after orthodontic treatment.[7] Despite the potential, the concept of utilizing Digital Twins in dentistry is still in nascent stages, but is likely to witness a monumental revolution in the coming decades.

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