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ROBOTIC APPLICATIONS IN ORTHODONTICS

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The last decade (2010-2021) has witnessed the evolution of robotic applications in orthodontics. The inherent advantages of robots are their high accuracy and precision, high work efficiency, and stability. Robotics is defined as the “intelligent connection between perception and action”. According to the Robot Institute of America, a robot is defined as “a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various

The discipline of orthodontics, since its very inception, has strived to improve the efficacy and efficiency of any kind of treatment delivered to patients.

The last decade, in particular, has marked magnificent growth in the field of robotic wire bending and robotic customization of CAD/CAM appliances, increasing the effectiveness and efficiency of arch wire bending and treatment. Nanorobots have been documented in the literature to be used for acceleration of tooth movement in animal studies through the use of nanoelectromechanical systems (NEMS) and nano LIPUS ultrasound devices. The concept of a smart bracket with an integrated nanomechanical sensor system for 3D force and moment real-time measurement has shown to work well, allowing precise application of force by an orthodontist. Robotics in orthodontics and their applications in implant placement and maxillofacial surgeries including cleft palate surgeries, improving surgical efficiency and precision. In 2017, the dental implant navigation robot system manufactured by Neocis Inc, called Yomi, received FDA approval and became the world’s first commercially available oral implant robot. Robots play a vibrant role in the treatment of TMD (temporomandibular disorder) through massaging robots, mouth opening robots, and neurological rehabilitative exoskeleton robots, promoting active participation of the patient and accurately tracking the progress of a patient over time, by using progressive therapy routines.

Artificial intelligence in the context of robotics, it is the field of autonomous and symbolic task planning that is used to automatically plan a sequence of actions to reach a specific goal.

Robotics in orthodontics was further subcategorized into eight domains:

1. Robotic dental assistants
2. Robotics in diagnosis, management, and simulation of orthodontic problems [1]
3. Robotics in orthodontic patient education, teaching, and training [1]
4. Wire bending robotics including labial and lingual wire bending robotic systems and customized fixed appliance robotics [1]
5. Nanorobots/microrobots for acceleration of tooth movement and for remote monitoring and telecommunication [1]
6. Robotics in maxillofacial surgeries and implant placement [1]
7. Robotics in automated aligner production [1]
8. Rehabilitative robots in management of TMD

The orthodontic specialty is moving forward towards a new era of data-driven and robot-assisted medicine. Robotics is by all means a breakthrough in the field of technology, and its evident applications in orthodontics are potentially immense. but the increased intuitiveness of the systems combined with broad educational efforts and introduction of affordable systems are key challenges that need to be over- come to truly introduce robotics to orthodontics.