International Journal of Oral Health Dentistry 2023;9(2):86–88

Content available at: https://www.ipinnovative.com/open-access-journals

International Journal of Oral Health Dentistry

Journal homepage: www.ijohd.org

Review Article

Robotics in dentistry: Heading towards techno-verse era

Nisha Agarwal[1], Surbhi Priyadarshi[1,*], Palak Jaggi[1], Rangoli Srivastava[2]

[1]*Dept. of Public Health Dentistry, Faculty of Dental Sciences, SGT University, Gurugram, Haryana, India*
[2]*Dept. of Public Health Dentistry, Teerthanker Mahaveer Dental College and Research Centre, Bagadpur, Uttar Pradesh, India*

ARTICLE INFO

Article history:
Received 29-04-2023
Accepted 10-05-2023
Available online 26-06-2023

Keywords:
Robotics
Dentistry
Artificial intelligence
Robots

ABSTRACT

The advent of robotics in dentistry can make both patients and dentists more comfortable. A robotic system is innovative, making a positive difference in the least invasive treatment, and dental robotics development is still in its infancy. To expand the use and adoption of this technology, numerous obstacles and problems must be overcome. In order to ensure that dental treatment and planning will be simpler, more affordable, and beneficial to providers, patients, and a wider segment of society, the field of dentistry and dental research has numerous tasks to play. The goal of this article is to discuss numerous initiatives to employ robotics in dentistry to support the dental departments that have pushed the boundaries of medical dentistry innovation.

1. Introduction

Dental robots, which are machines that carry out automatic manual activities controlled by a computer, have been considered important due to advancements in the developing field and general public awareness of oral health.[1] An oral examination, diagnosis, and treatment planning errors could result from dental professionals being physically and mentally exhausted after long shifts performing demanding operations in ergonomically challenged positions. Additionally, there is a chance that normal everyday tasks, such cleaning instruments and surfaces in the dental clinic, will be done carelessly in general. Robotics-enabled digital dentistry can reduce mistakes and improve the standard of patient treatment overall.[2]

Robotics is now a common scientific topic and societal issue due to the worldwide rapid growth of modern science and technology. Numerous industries, including machinery, electronics, aerospace, and medical, have used robotics. Among these, the use of robotics in medicine has drawn more and more attention. Macro-, micro-, and bio-medical robots are the three main categories of medical robots. Macrorobots primarily include rehabilitation robots, which also include minimally invasive surgical robots and medical endoscopic devices, and surgical robots, which also include brain- and eye-surgery robots. Rehabilitation robots include smart wheelchairs and home daily-care robots. Bio-robots are medical robots with human-like faculties of perception, thought, and judgement.[3]

There are encouraging developments in dentistry that could usher in a new era of robot-assisted care. It is possible to execute the therapy with accuracy, stability, and high flexibility. Robots can also carry out dental procedures on a large number of people without getting fatigued, raising the standard and breadth of healthcare in general.[4]

Dental robots are devices that carry out routine manual activities automatically under computer control. Along with improvements in machine learning, data analytics, computer vision, and other technologies, health robots will continue

* *Corresponding author*.
E-mail address: surbhipriyadarshi02@gmail.com (S. Priyadarshi).

https://doi.org/10.18231/j.ijohd.2023.016

to develop. All kinds of robots will continue to develop so they can carry out jobs on their own, effectively, and precisely.[2] This review focuses on the development and future uses of robotics in several branches of dentistry.

2. Applications of Robotics in Dentistry

With all the essential technology that may be easily and further improved, the use of robotics in dentistry is advancing. Some of the technologies are already in use in dentistry, including image-based implant surgery simulation, surgical guidance, and the use of intraoral scanners to create digital impressions of preparations from which a milling machine may create the restoration.[1]

2.1. Nanorobots

Nanorobots are extremely small machines made of nanoscale or molecular components that are measured in nanometers (1 nm = one millionth of a millimetre).[4] Nanotechnology may be used for local anaesthesia, dentition renaturalization, the long-term treatment of hypersensitivity, full-mouth realignment of orthodontics in a single visit, covalently bonded diamondized enamel, and ongoing oral health maintenance using mechanical dentifrobots, among other potential treatments. Using a computer to guide these tiny employees, dental nanorobots might be utilised to eliminate caries-causing bacteria or to fix tooth flaws where decay has already begun.[5]

2.2. Uses in prosthodontics

For long-term success, precise tooth preparation is crucial. The condition of prepared teeth might not be very good because of the limited amount of oral room, the trembling of human hands, and the limitations of physicians' specialised skills. A laser-controlled robotic device for crown preparation called LaserBot was developed to address this problem. These machines can operate the laser in three dimensions automatically to cut the teeth. In vitro research on human teeth demonstrates that the robot can replace manual crown preparation and that the precision can meet clinical needs. To achieve the correct occlusal connection, full dentures' tooth arrangement must undergo multiple little changes. A single controller automated system based on the CRS-450 robot, which was used for tooth arrangement in the entire dental production process, was developed to reduce the need for human labour.[6]

2.3. Uses in endodontics

A multifunctional endodontic microrobot was developed by Dong et al. in 2007 to advance root canal therapy. Understanding the automatic treatment process through computer control by fixing it on the patient's teeth can help you understand probing, drilling, cleaning, and filling. Robots can also help the doctor prepare the cavity by running the drill with precision and smoothness, reducing iatrogenic damage.[7]

2.4. Uses in oral & maxillofacial surgery

Due to the strong demand for aesthetics in dentistry, interest in this topic is significant despite the complexity of the anatomical features of the mouth and its surrounding structures. As a result, the orthognathic treatment should be carried out precisely and with little damage.[6] The robot can be used under a variety of circumstances in the maxillofacial operation for the convenience of the specialist, according to experiments on living pigs' mandibles. The robot can collaborate more effectively with the skilled efficiency in the constrained operation environment surrounding the surgical table thanks to its position memory capability.[8]

3. Limitations

Female patients are less inclined to undergo treatment from robots due to the expensive setup, unclear patient acceptance, and compliance among dentists. In terms of the initial cost, maintenance, the requirement for additional components, and the necessity to program the robot to perform the task, practical robots are typically expensive.[9]

4. Future Recommendations

The use of robots in dentistry increases precision, reproducibility, and dependability; yet, because there aren't many accessible systems, there hasn't been much research done in this area.[10] Effective cooperation between dentists and engineers is required. Robots may also be able to enhance healthcare, increase the effectiveness of transportation, and offer us greater flexibility to engage in creative activities by taking on the load of physically taxing or repetitive work.[11]

There are a whole new set of health and safety concerns that arise as we start to compare the speed and efficiency of humans against robots. Some robots have actuators and sensors that are more capable than those found in people. Robots are replacing people in various industries, which can cause economic issues.[12]

According to reports, there may be 20 million robots in existence by the year 2030, and automated workers may replace up to 51 million workers at that time. We can therefore anticipate seeing more robots in our daily lives, even though they might not take over the planet. However, recent advancements in artificial intelligence and machine learning suggest that future interactions between humans and robots may expand.[13]

5. Conclusion

Although the robotic world of accuracy and precision is discussed and used in many fields, it still has a number of limitations. Humans being replaced by robots is considered science fiction in undeveloped nations. The desire to advance is constant. Therefore, although robotic dentistry is currently a work of fiction, it may become such in the future.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Rawtiya M, Verma K, Sethi P, Loomba K. Application of robotics in dentistry. *Indian J Dent Adv*. 2014;6(4):1700–2.
2. Grischke J, Johannsmeier L, Eich L, Griga L, Haddadin S. Dentronics: Towards robotics and artificial intelligence in dentistry. *Dent Mater*. 2020;36(6):765–78.
3. Dario P, Guglielmelli E, Allotta B, Carrozza MC. Robotics for medical applications. *IEEE Robot Autom Mag*. 1996;3(3):44–56.
4. Cheema HS, Dhillon PK. Robotics in dentistry. *Dentimedia J Dent*. 2012;17:61–2.
5. Shetty NJ, Swati P, David K. Nanorobots: Future in dentistry. *Saudi Dent J*. 2013;25(2):49–52.
6. Wu Q, Zhao YM, Bai SZ, Li X. Application of robotics in stomatology. *Int J Comput Dent*. 2019;22(3):251–60.
7. Dong J, Hong S, Hesselgren G. WIP: A Study on Development of Endodontic Micro Robot. *Int J Mod Eng*. 2007;8:26–34.
8. Burgner J, Müller M, Raczkowsky J, Wörn H. Ex vivo accuracy evaluation for robot assisted laser bone ablation. *Int J Med Robot*. 2010;6(4):489–500.
9. Kyrarini M, Lygerakis F, Rajavenkatanarayanan A, Sevastopoulos C, Nambiappan HR, Chaitanya KK, et al. A survey of robots in healthcare. *Technologies*. 2021;18(1):8.
10. Yoon SN, Lee D. Artificial intelligence and robots in healthcare: What are the success factors for technology-based service encounters? *Int J Healthc Manag*. 2019;12(3):218–25.
11. Alotaibi M, Yamin M. Role of robots in healthcare management. In: 2019 6th International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, India. IEEE; 2019. p. 1311–4.
12. Kolpashchikov D, Gerget O, Meshcheryakov R. Robotics in healthcare. In: Handbook of Artificial Intelligence in Healthcare. vol. Vol 2. Switzerland AG: Springer Nature; 2022. p. 281–306.
13. Riet T, Sem K, Ho J, Spijker R, Kober J, de Lange J, et al. Robot technology in dentistry, part one of a systematic review: literature characteristics. *Dent Mater*. 2021;37(8):1217–26.

Author biography

Nisha Agarwal, Intern

Surbhi Priyadarshi, Senior Lecturer

Palak Jaggi, Intern

Rangoli Srivastava, Post Graduate Student

Cite this article: Agarwal N, Priyadarshi S, Jaggi P, Srivastava R. Robotics in dentistry: Heading towards techno-verse era. *Int J Oral Health Dent* 2023;9(2):86-88.