

# Use of Robots in Dentistry: A Fact or a Fiction

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## **Abstract**

Robotics is the most enthralling example of human invention which has the potential to replace the human factor altogether. Slowly but surely this invention is also making its way in dentistry too. The robotics coupled with artificial intelligence is being modified and customized to be used in the Dentistry. The advantage of robotic technology includes precision work delivered in a fatigue-less manner. This paper revisits the present use of robotic technology in dentistry and its future applications.

**Keywords:** *Robotics, Artificial Intelligence.*

## **Introduction**

The traditional dentistry is increasingly becoming the object of past reconciliations as more and more clinicians are opting for new technologies to further their practice. The technologies which were previously just ignored based on the investment involved or the complicated training associated are now being increasingly getting incorporated in clinician's daily clinical regimens. Let it be intraoral cameras to the use of radiovisiography or use of lasers to microscope driven endodontics and digital impression, the technology-driven dentistry has arrived in our daily practice. But there is one more attribute to this modern era of practice that is robotics which is yet to make a grand entrance into this field but is already making its presence felt.

The world of robotics has lots of features that can be adapted & utilized in dentistry. Some of the Robotic technology which is currently being used is like placements of implants by a distant placed skilled clinician, who controls the robotic arm via the computer to place the implants. Robotic arm on the other hand eliminates human error by eliminating any hand tremors or fatigue which are usually associated with the human factor during surgeries. Even the surgical guides for the implant placement and the restorations which are milled post placement of implants are also done using an automated robotic unit only.

## **Dental use of robotics presently used:**

**Training robots for Pre-clinical dentistry:** Earlier during the pre-clinical prosthodontics or preclinical conservative, the students used to practice their skills on the phantom head, which is nothing but an adjustable mechanical replica of cephalic region with a simple arrangement of teeth allowing for practicing crown and cavity preparations<sup>(1)</sup>. The phantom head was in no way able to improve the clinical skills of the student concerned as students could manipulate it in a manner convenient to them but not according to the mandatory clinical assertions.

But in Japan, they are already using a robot named Showa Hanako which has artificial intelligence to simulate different types of patient attitudes, gestures, and responses to make the student experience what it feels like to work on a real patient<sup>(1)</sup>. There is also a group of robots corresponding to the family of Geminoids which are equipped with advanced motion-sensor technology which allows the machine to mimic facial expression and precisely imitate head motions<sup>(1)</sup>. The robot is first in the series of personalities outside Japan and is intended to push forward the android science and philosophy, in searching for answers to fundamental questions.

**Endo microrobots:** Endodontic mishaps can occur by even the best of the endodontists like file breakage, ledge formation, apical foramen perforation, and

excessive instrumentation<sup>(2)</sup>. To reduce the potential for human error and improve the quality of endodontic treatment, it is necessary to develop advanced endodontic technology innovation by applying advanced engineering and computer-aided technology<sup>(3,4)</sup>

This computer-controlled machine will be mounted on several teeth within the patient's mouth. With on-line monitoring and intelligent control, the micromachine or robot will perform the automated drilling, cleaning, and filling of the root canal. All other sub-project results will be incorporated into this robotic operation. Specific objectives for microrobot design include:

1. Reducing the reliance on the skills of the dentist,
2. Minimizing human error
3. Offering a method for precise diagnosis and treatment<sup>(5)</sup>

**Dental Nanobots:** Nanobots or nanorobots as they have come to be known are miniature robots of the size of nanometers that is of the scale 1 nanometer is equivalent to 1 millionth of 1 mm constructed with the help of nanoscale or molecular components<sup>(6)</sup>. The application of the nano-robot technology can be used in local anesthesia, re-naturalization of the original attrited or damaged dentition, orthodontic alignment in a single visit, curing hypersensitivity and maintenance of the oral hygiene using mechanical dentifrobots. Using computer technology for guidance these nanorobots can also be directed to kill bacteria in the cavity or repair the tooth damage hence occurred as a result of bacterial activity<sup>(7)</sup>.

**Surgical Robots:** Robots can be used extensively in maxillofacial surgery in collaboration with a maxillofacial surgeon to correct the deformity or injuries to the face. A surgical robot programmed by the surgeon through interactive programs, does the pre-programmed task of repairing the human face<sup>(8)</sup>. Robotics have long been used in the milling of the bone surfaces, drilling of holes, deep saw osteotomy cuts, selection of osteosynthesis plates, and orthognathic surgery planning<sup>(9)</sup>.

**Sensor -Equipped Implant Set up:** Dental implant is used to replace the root form of the missing tooth by placing a titanium implant body in the bone & allowing it to Osseo-integrate with the bone. Considering the mistakes done by a human clinician in the placement of these implant bodies into the bone, which also affects the overall prosthetic outcome a computer-assisted surgery has been developed for oral Implantology

which includes pre and intraoperative procedures. The preoperative surgery is to use three-dimensional (3D) views as provided to enhance raw images obtained from the patient before the operation. The main aim of this technique is to render a target region and a pathway associated with relative organs from computed tomography (CT) data. It provides 3D orientation of surgical instrument position and trajectory displayed on a monitor in real-time within the patient's 3D imaging data<sup>(8)</sup>. Yomi a robotically assisted implant system that is cleared by FDA utilizes patients C.T scans to plan the implant procedures for the patients<sup>(10)</sup>. Recently a robot dentist installed two implants on a female patient using the same technology with an error margin of 0.2-0.3mm<sup>(11)</sup>.

## Conclusions

Although robotics coupled with programmable software technology provides humanity with precision and accuracy and is being implemented in many areas, it comes with its limitations per se. Apart from the extensive research and development still required in this area along with elaborate equipment requirements and ethics involved, the economic factors make it difficult for the developing countries to replace humans with machines. Although with changing times this may change soon and robotic dentistry may become a fact from fiction.

**Funding:** Nil

**Conflicts of Interest:** There are no conflicts of interest

**Ethical Approval:** Approved

## References

1. <http://gizmodo.com/5862512/simroid-trains-future-human-slaves-in-robot-dental-hygiene>.
2. Burns RC, Herbranson EJ. Tooth morphology and cavity preparation In Cohen S Burns, RC, Editors: Pathways of the Pulp, 7edn, St Louis, Missouri, The C. V. Mosby, 1997 pg 150-202.
3. West JD, Roane JB. Cleaning and Shaping the Root Canal System. In Cohen S Burns, RC, Editors: Pathways of the Pulp, e7 edn, St Louis, Missouri, The C.V. Mosby, 1997, pg 203-257.
4. Dong J. Rule-based Planning for Automated Endodontic Treatment - From Dental Radiography, 3-D Computer Modeling, to Tool Selection and

- Path Control. Dissertation, Columbia University 2003; 149-153.
5. Schulz MJ, Shao VN, Yun Y. Nanomedicine Design of Particles, Sensors, Motors, Implants, Robots, and Devices, Artech House, 2009; 10.
6. Lumbini P, Agarwal P, Kalra M, Krishna KM. Nan robotics in dentistry. *Ann Dent Spec* 2014;2:95-6.
7. Shetty NJ, Swati P, David K. Nanorobots: Future in dentistry. *Saudi Dent J* 2013;25:49-52.
8. Rawtiya M, Verma K, Sethi P, Loomba K. Application of robotics in dentistry. *Indian J Dent Adv* 2014;6:1700-6.
9. Bansal A, Bansal V, Popli G, Keshri N, Khare G, Goel S. Robots in head and neck surgery. *J Appl Dent Med Sci* 2016;2:168-75.
10. Yomi, the First Robotic Dental Surgery System Now Cleared by FDA. Available from: <https://www.medgadget.com/2017/03>.
11. Atine V. South China Morning Post Newspaper; 22 September, 2017.