SVOA Dentistry

ISSN:2753-9172

ScienceVolks Open Access

Mini-Review

Robotic Applications in Orthodontics: Overview of Existing Research

Sachin Philip[1]*, Kajal[1], Varun Goyal[1], Gurkeerat Singh[1], Sridhar Kannan[1], Raj Kumar Singh[1], Ankit Chaudari[1] and Triparna Kapoor[1]

[1] *Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India.*

***Corresponding Author**: Sachin Philip, Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India.*

DOI: https://doi.org/10.58624/SVOADE.2023.04.0161

Received: *October 16, 2023* ***Published:*** *December 08, 2023*

Abstract

Malocclusion is the world's third most common oral ailment. The fixed orthodontic procedure is now the most successful treatment strategy for malocclusion. Archwire bending is an important part of orthodontic therapy. However, because to the great stiffness and exceptional flexibility of orthodontic wire, it is a very difficult task. The old method of obtaining the created archwire curve is dependent on manual operation, which would bring various errors induced by human causes. Customised archwires are required in clinics for lingual orthodontics treatment. Previously, only expert orthodontists could physically bend these archwires. This is a pattern demands specialised skill training, precision, and extensive chairside time, but cannot guarantee the accuracy of appliances. So, what are the most recent developments?

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

Introduction

A robot is a machine particularly one programmable by a PC equipped for completing an unpredictable arrangement of activities naturally [1]. Robots can be managed using an internal or external control system, as well as an integrated control. Nowadays, industrial settings use robots in areas of manufacturing techniques, medical disciplines, and military applications and analysis. It's significant that a variety of robots are being created to evaluate in a range of positions in the medical setting [2]. Other applications for robots include minimally invasive surgery, more accurate and controlled surgical manipulation, where magnification improves the surgeon's vision, and shorter hospital stays for recovery.

Similar to how medicine has grown greatly from conventional practises to the modern era, dentistry has also expanded the scope of dental treatment and systems [3]. It is capable of performing the following tasks: creating whole or partial dentures, performing dental implantology, and bending archwires. The software of the dental expert system incorporates the knowledge and skills of the technician and dental professional [4]. Because of advancements in three-dimensional imaging and manufacturing techniques, orthodontic equipment can now be customised to increase treatment efficiency. The Insignia® system (Ormco Corporation, Orange, CA, USA) and Suresmile® archwires (OraMetrix, Inc., Richardson, TX, USA) are two patient-specific products that use computers to create an interactive treatment plan before manufacturing a custom-designed appliance. [5]

Robots have various uses in the orthodontic sector, and the following are the most popular robot-assisted treatments:

Insignia:

The Insignia framework provides physicians with software that allows them to plan and create the final occlusion, and then sections and archwires are calculated to move teeth to the desired outcome. Patient-specific brackets, indirect-bonding transfer jigs, and bespoke archwires are available from the company.

The custom archwires are created by a printing robot that uses the given technology to trace and bend the wire. The robot is very efficient and has an extremely tiny error margin [5]. In the Insignia collection, the American Board of Orthodontics (ABO) ratings were reduced, indicating that the completed outcomes were closer to those characterised by the ideal ABO standards. Furthermore, the mean treatment time was significantly lower in situations treated with Insignia (14.23 months against 22.91 months), and those patients were dealt with by roughly seven fewer arrangements overall than the normally treated patients. It was noted that the habitually treated group had a small sample size and that the underlying companion evaluation rating scores were low in both groups. As a result, the findings of this study may not have a major influence on patients with progressively severe malocclusions. Larger sample size randomised clinical trials are necessary.

Suresmile:

The orthodontist begins the process by utilizing digital photos taken using a white light scanner of a patient's mouth and teeth CBCT standing for Cone Beam Computed Tomography. He then takes the teeth and only adjusts them into the proper position. The 3D image data is transferred to a computer for further refining. The brackets and wire's placement and tension are specified. The dentist inputs data into the computer, and the data is sent by Internet connection to the SureSmile headquarters. The robots arrive at this point. The orthodontic wire is held in place by two automated pliers which heats and twists the wire into a pattern that will keep the teeth in place in their preferred posture [6] SureSmile is a cutting-edge system that uses 3-D imaging and PC technologies for diagnostics and treatment planning, as well as mechanical technology to adjust fixed orthodontic equipment. [6]

LAMDA:

A lingual archwire manufacturing and design aid (LAMDA) is used for a precise, quick planning and bending of orthodontic archwires. Because this system can only perceive movement in the XY plane, it cannot bend the archwire with a closed loop [6].

MOTOMAN UP6:

Another type is MOTOMAN UP6-based archwire bending robot which is built of a computer and an archwire bending actuator. This is connected to the MOTOMAN robot end and is used to balance and bend the archwires. This robot examines several items such as bending position, point of enhancement of the curve wire, kinematics, and bending qualities. [7]

Cartesian type archwire bending robot:

The base, rotating, feed, and supporting structure of archwire, bending die, and other components comprise the archwire bending robot component. as well as an archwire bending mechanism. The method for bending the orthodontic archwire is inspected, as well as the orthodontic structure. Solid-works software is used to design the archwire bending robot. Precision control using a pure acceleration/deceleration of third order profile of the archwire bending robot has been set up. Orthodontic Cartesian coordinates are used in archwire bending experiments. The archwire bending robot framework created the archwire [4].

The challenges of future robots applications in dentistry:

The basic design requirement: The restricted space robot bends the archwire with the use of a three dimensional oral character. The fundamental issue with the structure and assembly for a robot in orthodontics is whether it can satisfy the interest of the various the patient's mouth features after oral fixation. Orthodontic archwire should be quantitatively conveyed for orthodontics archwire bending robot. To comprehend the precise archwire bending, the archwire spring-back and bending point planning should be broken down. [6]

Difficulty of Research: Because the function of the robot application in orthodontics is unique, the research difficulty is also unique. The spring-back analysis and bending algorithm of archwire, as well as the development of customised orthodontics archwire, are the research difficulties of the orthodontics archwire bending robot system [6].

Conclusion

Orthodontic treatment which employs a robot or a machine to manipulate archwires for fixed orthodontic appliances has an excellent outlook with significantly less treatment time than the conventional method, in which a technician bends archwires instead of a machine, but with greater precision and dropped patient discomfort. The most common ways for using robots in archwire bending are Insignia and Suresmile, both of which have proven to be superior to other procedures.

While there is promise in terms of precision and efficiency, further research is necessary to optimize the integration of robotics into orthodontic workflows, addressing technical, regulatory, and cost-related considerations.

References

1. Definition of 'robot'. Oxford English Dictionary (2016).

2. Staples P. "Robots Used in Everyday Life". Sciencing (2018).

3. B Divya Bhat., et al. "Robotics in dentistry: Fiction or reality". Journal of Dental Research and Review 4 (2017): 67-68.

4. Jin-Gang Jiang YDZ., et al. "A Review on Robot in Prosthodontics and Orthodontics". Advances in Mechanical Engineering 7 (2014).

5. Aldrees A. "Do customized orthodontic appliances and vibraion devices provide more efficient treatment than conventional methods?". The Korean Journal of Orthodontics 46.3 (2016): 180.

6. Ahmad S Kh., et al. "A Glance about the Applications of Robot in Orthodontics". International Journal of Innovation and Scientific Research 22.1 (2016): 178-182.

7. Kumar P. "Future Advances in Robotic Dentistry". Journal of Dental Health, Oral Disorders and Therapy 7.3 (2017).

Citation: Philip S, Kajal, Goyal V, Singh G, Kannan S, Singh RK, Chaudari A, Kapoor T. Robotic Applications in Orthodontics: Overview of Existing Research. *SVOA Dentistry* 2023, 4:6, 273-275.