"Renaissance of Impressions: Digital Impressions"

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Abstract

Digital impressions are the need for the hour. In this era of machines the standard impressions are being replaced by the virtual impressions. These virtual technologies go hand in hand with milling units. These are readily accepted by the practitioners and patients. Being comprehensive with processing units they save a lot of time and reduces the discomfort to the patient. A lot of research is waiting in this field for exploration.

Key words: Digital Impressions, CAD/CAM, Oral Scanners

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Introduction

The development of technology has led to revolutionary changes in dentistry. From a simple restorative procedure to complex full mouth rehabilitations, almost everything has changed in the past 50 years. The exploration of science and technology and linking it with dentistry has made difficult and challenging procedures easier than what they were two decades back. Be it digital articulators, new and improved endosseous implants, lasers, piezoelectricity and others. All such recent advances have entered into day to day clinic practices.

Amongst one is CAD/CAM and digitally printed or laser sintering applications which is the one to ease the fabrication of prosthesis. They have reduced the lab time and work more precisely. To work in comprehension with such a technology, input has to be provided in the digital language only. Such a requirement led to birth of digital scanners which are required to make a digital impression.Digital impression making, though in its juvenile phase but has achieved a lot of appreciation from the current practitioners. Dr. Duret was the first one to introduce CAD/CAM to the dentistry in 1971[1]. And CEREC was the first commercially available digital scanner.[2]

Initially for any CAD/CAM procedures a plaster cast obtained from silicone impressions was scanned with lab scanners. But the precision of accuracy of plaster cast is not in accordance with the CAD/CAM results and degrades the quality of final output. Moreover, it is also helpfulin reducing lab time and it is more adaptable towards patient care. Patients show a preference towards intraoral scanners rather than standard impressions using impression materials carried in impression trays. Also the time required with the standard impression materials to set and pour a cast is eliminated making more time available for the clinician. These all factors help improve the practice and are greatly welcomed by the practioners as well as patients. For a digital procedure to be carriedout, three prerequisites are mandatory: a digital scanner to pick up the tissue area(to make an impression), a software which could convert this imaging file into a workable platform on which prosthesis can be customised and the directions be sent to the production unit. And finally some sort of milling unit such as CAD/CAM, 3d printers or laser sintering units. All three are mandatory to fabricate a prosthesis into its final shape before delivering it to the patient.

The various systems available nowadays for making digital impressions include CEREC, E4D Dentist, Cadent iTero, Lava Chairside Oral Scanner C.O.S, FastScan and Densys3D Solution.[3]

CEREC System

This was 1st introduced to the dentistry in 1987. It works on the principal of "triangulation of light". In this technology a light source directs the light to the object to be analysed and is reflected back and is analysed by the detector. A timed laser light is used to direct at the tooth structure which is reflected back to the camera and the data are captured to register the image. Its previous version CEREC AC Bluecam was quite popular and works on capturing images by using blue light from blue diode LEDs as light source.[4,5]It has the speed of 1quadrant per min. it was replaced by CEREC AC Omnicam in 2012.The Omnicam imaging technique works on continuous imaging which generates the 3d model of the object in comparison to single dimension images created by Bluecam. Omnicamcan be used for a single tooth, quadrant, or full arch.[6,7] It generates and captures the images in most precisely picked colours in comparison to previous versions. It scans the fields free from any powder form. This powder is of titanium dioxide used as antiglare in case of reflection from highly translucent surface of teeth which can interfere with the imaging. The latest version has also incorporated feature to detect any shaking which could distort the images. This system is in accordance with the CEREC MC and CEREC INLAB, chairside and lab milling units, respectively.[8,9]

Lava C.O.S. System

It is Lava Chairside Oral Scanner marketed by 3M ESPE,Seefeld, Germany. It became commercially available in 2008.It works on the principal of "active wave-front sampling technology".[10]These scanning systems use a lens with a rotating aperture to capture the oral images.This captures images in a video sequence and models the data in real time (≈ 20 3D data sets per second). It generates more than 2400 datasheets to increase the precision. It has the smallest scanning tip with 13.2 mm in dimensions. It also utilizes the pulsating blue light wavelength. The antiglare powder is sprinkled on to tooth surfaces and the imaging is recorded on scanner and is viewed directly. All the sides are scanned and the last imaging is again scanned from the buccal aspect in occlusion to record the jaw relation. The images so recorded are transferred to the manufacturer and a stereolithographic model is created and is transported to the lab for fabrication of prosthesis. It acts as a semiopen system because file generated are generally encrypted and can be used in some certain CAD/CAM software which support this system.[11]

ITero system

This system was commercialised by Cadent Inc (Carstadt, NJ) in 2007. It works on the principal of "parallel confocal imaging technology". [12]100,000 points of red parallel laser light perfectly

focus at 300 focal depths of tooth structure that converts the reflected light into digital data. The beam of red laser light works as the optical probes when contacting the object surfaces and records the anatomic surface details by detecting the confocal points.[13] This system is powder free as it doesn't require any powders. Scanner tip is moved in all the directions and the centric occlusion is also recorded to transfer the bite record. The cadent system lab receives the information and fabricates the resin dies to be worked upon for final prosthesis fabrication. Being an open system this generates a "stl" file which can be used with any CAD/CAM units which are compliant with stl file. iTero has partnership with Straumann implant system..[14] They fabricate their components in accordance with Cadent inc so that images can be picked easily.

E4D system

This system was marketed by D4D technologies, LLC. It works on the principle of "optical coherence tomographyand confocal microscopy". It uses red laser as a lightsource and micromirrors to vibrate 20,000 cycles per second.[15]E4D's high-speed laser captures digital impression of teeth to create an interactive 3Dimage.The image can formulate a precise virtual model in seconds. This system also does not require powder for intraoral scanning. The scanning is carried out with the help of tip which is controlled with foot. It doesnot obtain the jaw relation by scanning from buccal direction. Instead it scans the bite registration material which is used for adjusting interocclusal height of the prosthesis. The E4D file so created can be easily converted to stl file and can be used with any of the milling system.[16]

TRIOS

This system was launched by 3Shape in 2011. This works on the principal of ultrafast optical sectioning and confocal microscopy.The system recognizes variations in the focus plane of the patter nover a range of focus plane positions while maintaining a fixed spatial relation of the scanner and the object being scanned.[17]It scans upto 3000 images per second.[18] A final digital 3D model can instantly be created which can create the real configuration of teeth and gingival color. Similar to the iTero and E4D systems, the TRIOS intraoral scanner is a powder-free device in the scanning process.

Steps in digital scanning[19]

Step 1. File creation: Patients data, tooth number and type of restoration (full crown, veneer, inlay or onlay) desired is feeded in the computer.

Step 2. Scanning: The working model with the die(s) trimmed is scanned and digitally captured and transferred into computers virtual laboratory.

Step 3. Virtual model: The 3D virtual model is then presented on the screen and can be rotated and viewed from any angle.

Step 4. Design: Virtually section the model and remove the die. The borders of final restoration are defined. The desired contact areas are marked electronically on adjacent teeth.

Step 5. Database selection: The tooth design is selected by examining the surrounding dentition and the computer thus proposes a restoration.

Step 6. Virtual placement: The position and rotation of the crown can be altered and it will automatically readjust the restoration's contours, contacts and marginal ridges to new position.

Discussion

Digital impression making is renaissance which is going to stay for a very long time in the field of dentistry. With each exploration, the capabilities of these systems expand, and improvements in technique sensitivities, user friendliness, computing power, and the quality of the restorations are usually evident as well. But as the future approaches, the systems and materials available to us will continue to evolve, improve, and enhance dentistry.[20]

Conclusion

Digital impressions and manufacturing of prosthesis with the help of technology is the key to future. But it is still in its formative years. A lot of research and development is still waiting to be done in this field.

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