

Intraoral Scanners: A New Era in Prosthodontics

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ABSTRACT

Background: Increased use of emerging technology in prosthodontics has resulted from rapid and persistent developments in computer sciences. One of them is an intra-oral scanner. Intraoral scanners (IOS) are devices used in dentistry to acquire direct optical impressions. Optical impressions reduce patient discomfort, and they are particularly useful in conditions where conventional impression techniques are contraindicated. A paradigm shift in prosthodontics reflects the replacement of alginate and polyvinyl siloxane (PVS) impressions with optical intraoral scanners. In dental practises, the implementation of the IOS device coincided with the advancement of CAD / CAM (computer-aided design and production) technology for best performance. The current IOS can be used with good accuracy to capture impressions for variety of prosthodontic procedures. As the use of scanners is increasingly adopted by dental practises, it can be fair to assume this degree of accuracy in impression taking and scanning. This review will give more light on the use of IOS in prosthodontics.

Keywords: Intraoral Scanners, Digital Impressions, 3d imaging, Accuracy.

INTRODUCTION

Intraoral scanners (IOS) are instruments in dentistry for the capture of direct optical impressions. Recent developments have now included e-study models and now intra-orally scanned study models. Impression has its significance in various aspects of dentistry, especially in prosthodontics; impression must be produced using various materials and techniques to perform different procedures. The intraoral scanner is used to assess, either intraorally or extraorally, the entire 3-dimensional (3D) of the external surface of a physical object from many directions¹.

The current IOS is sufficiently precise to catch impressions on both natural teeth and implants for the manufacture of a whole series of prosthetic restorations (inlays / onlays, copings and frameworks, single crowns and fixed partial dentures); moreover, they can be used for smile modelling and for the manufacture of posts and cores, removable partial protheses and obturators. Finally, for guided surgery, IOS can be incorporated into implant dentistry¹. The intraoral scanner is used either intraorally or extraorally from different

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directions to determine the entire 3-dimensional (3D) of the outer surface of a physical object².

Advantages	Disadvantages
Less patient discomfort	Difficulty in identifying deep marginal lines of teeth prepared
Time-efficient, Simplified clinical procedures	Learning curve
No more plaster casts	Purchasing and managing costs ¹
Good interaction with the dental technician and with patients	

Evolution of digital impression systems

The advent of automated intraoral scanners coincided with the growth of CAD / CAM technology (Computer-Aided

Design and Manufacturing) and the introduction of Chairside Economic Restoration of Esthetic Ceramics (CERE) in 1984.

- The first dental office system was CEREC 1 in 1986. Prof. Dr. Werner Moermann developed the system in Switzerland.
- In 1994, 2000 and 2003, respectively, the Cerec 2 and subsequent Cerec 3 and the eventual Cerec 3D system replaced the initial technology. At Bronte 's Technologies in Lexington, Massachusetts, the Lava™ Chairside Oral Scanner (C.O.S.) was developed.
- In 2006, Cadent developed an in-office iTero digital printing system that by 2008 was capable of full-arch intraoral scanning and launched the iOC system in 2009 for iTero users.
- In October 2012, the True Definition scanner was introduced by 3 M ESPE.

Six months later, for its Insignia and Clear guide appliance systems, Ormco published the Lythos digital impression system.

The True Definition scanner became competent for Invisalign case submission in January 2014, so that True Definition scans can now be used for Invisalign submission and iTero scans for the Incognito device system 3.

Scanning technology

There are three key components of each scanner: a wireless mobile workstation to facilitate data entry; a computer monitors to review digital files; and a portable camera wand to gather data from the scan in the mouth of the patient.

Energy from either laser light or white light is projected onto an object from the wand and reflected within the wand back to a sensor or camera to capture surface data points. Tens or hundreds of thousands of dimensions are taken per inch, depending on algorithms, leading in a 3d view of the shape of the object. Measurement speed, resolution, and accuracy of the scanner are determined by the technology used by the wand to capture surface data². The goal of IOS is to record the three-dimensional geometry of an object with precision. The multimedia format that is most commonly used is the open STL (Standard Tessellation Language) or locked STL-like.

Four types of scanning technology are currently employed

- i) Triangulation
- ii) Parallel confocal imaging
- iii) Accordion fringe interferometry (AFI)
- iv) Three-dimensional in-motion video³

Scanning is carried out by quadrants, beginning at the most distal molar in the lower left buccal quadrant. The wand is placed at an angle of 45 ° to the gingival margin so that both the buccal and the occlusal landscape are captured and one tooth at a time is shifted medially, with an overlap between consecutive scans. On the lingual hand, starting with the lower left lingual quadrant, the sequence is repeated. It takes 10-15 minutes for a full-mouth scan and bite registration.



Fig 1: Intraoral digital scanner in use.

There are several commercially available methods for scanning intraoral surfaces in detail in dentistry today-

Powder painting scanner The principle of this type of scanner is triangulation technique. Triangulation is based on the principle that by knowing the positions and angles of two points of view, the position of a point of a triangle (the object) can be calculated. These two points of view can be produced by two detectors, a single detector using a prism, or captured at two different points in time.

Active wave-front sampling scanner: With this technique, Powder is also required, a lens with a rotating aperture is used instead of using laser light to capture data of the prepared tooth that allows 3D data to be digitised in a video sequence and models the data in real time. An example of this kind of scanner is the intraoral scanner (Iava ® C.O.S.iv) by 3 M ESPE.

Parallel Confocal laser scanner: Here, without the need for a contrast agent (powder), laser use enables scanning of a variety of different surface types and colours. A laser beam is projected to the surface of the instrument and the gingiva without a powder by its powder-free scanning⁴.

Digital scans can be stored indefinitely on hard discs, while standard versions, which can crack or chip, need to be stored physically, requiring extra office space. The 7 current prosthodontic intra-oral scanning devices are described below

i) iTero ii) Lava C.O.S.iii) Care stream Dental's CS 3500 iv) The True Definition Scanner v) 3 Shape's TRIOS Vi) Cirona's CEREC and Apollo System vii) The Lythos Scanner

USE OF IOS IN REMOVABLE PROSTHODONTICS

Full denture manufacturing through IOS and CAD-CAM has been shown to suit the underlying tissues better and to provide a reduced number of appointments before the final delivery of the denture.

By using laboratory scanners for data entry, occlusal rims and usable impressions (with border mouldings) can be digitalized.

Then with a unique CAD software, denture is digitally created. For the simulated aesthetic assessment and digital try-in session, the facial scans are obtained using intraoral scanners in a completely digital workflow, either considering no practical moulding of borders or using a finger to stretch the mucosa and catch its reflection. Such a technique has been documented to provide adequate retention of a denture⁵

IOS can also be used to scan soft and hard tissues for the digital/virtual design of cast partial framework, later CAD-CAM can be used to fabricate final cast framework, providing comfort to patient by reducing chair time and appointments⁶.

USE OF IOS IN FIXED PROSTHODONTICS

The new IOS is sufficiently precise to catch impressions on both natural teeth and implants for the creation of a whole series of prosthetic restorations (inlays / onlays, copings and frameworks, single crowns and fixed partial dentures)⁷.

They can be used for smile design⁷

Fabrication of posts and core and can be used in measurement of post space⁸

For guided surgery, IOS can be incorporated into implant dentistry. The scan program processes the photographs of the dentogingival tissues (as well as the implant scan bodies) collected by imaging sensors^{1,9}.

IOS are very useful in full mouth rehabilitation cases, along with CAD-CAM double scanning technique, they provide complete digital workflow¹⁰.

CONCLUSION

Exciting new advances in dental scanners and computer technologies have contributed to the growth and success of contemporary dental CAD / CAM technology in recent years. In dental practice, the implementation of 3D digitization methods is a modern and new choice for dentistry to establish an alternative technique to the traditional impression process, especially in the field of prosthodontics. Digital technology scanner systems made it simpler, quicker, more precise and more predictable to do what had previously been manual tasks. Compared

to traditional alginate and PVS impressions, intraoral optical scanners are becoming central to the new prosthodontic office, improving both practise efficacy and patient experience.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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