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Choosing The Right Intra Oral Scanners – A Review

Dr Kangaiyan S
Junior Resident, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

Dr Varsha Murthy
Prof & HOD, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

Dr Lakshmi Devi M
Professor, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

Dr Balaji Jayachandran
Professor, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

Dr M Sadish
Reader, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

Dr. Devameena S
Reader, Dept of Prosthodontics, Sri Venkateshwaraa Dental College, Puducherry

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Abstract: Each intraoral scanning system is different from each other for capturing the different surfaces like dentin, enamel, restorations, prosthesis or soft tissue. Metal and other reflective materials can be difficult to capture intra orally. The powder technique is a perfect solution to improve scanning accuracy by generating surface homogeneity. Presence of edentulous areas is another clinical situation that can compromise accuracy. It is difficult to acquire digital impressions accurately in the area with lack of teeth due to the apparent anatomical landmarks. Selecting a right intraoral scanner for selected treatment plan plays an important role for precise treatment outcome.

Keywords: Intraoral scanners; Dental caries detection; Implant supported prosthesis; digital smile design; completely edentulous

Introduction:

Depending on different needs for clinical procedures. a particular intra oral scanner may give best results This technique replaces more traditional poly vinyl siloxane impressions. For example, a

scanner can produce a 3D impression of a tooth with a cavity that a provider or patient can see from multiple angles.[1]

The intraoral scanner represents the most innovative development in dentistry in recent years. Digital dentistry, with the help of scanning technology, makes three-dimensional printing or reproductions of prostheses possible. It also helps users to better understand the nature and causes of various severities, which can convey proper treatment.[1] Other benefits of intraoral scanning include better comfort for patients with gag reflexes, better infection control and increased hygiene, More precise digital impressions that are easier to transmit to colleagues and labs for smoother collaborations and better workflows, the ability to transmit images digitally without the use of stone models, which take more time to create, Reduced time commitment by patients, Increased image accuracy, Cost savings due to eliminating the need for impression material and shipping expenses.[2]

When in the market for an intraoral scanner, a clinician should consider how well a particular device will fit into their unique practice, given the services they offer and the types and numbers of patients they serve. Several factors should be examined when choosing a scanner.

Selecting the proper intraoral scanner can improve patient care, promote dental best practices, and contribute to business sustainability. Even when the uses and benefits of an intraoral scanner are apparent, it can be daunting to select the proper tool without understanding factors like accuracy, cost, design, and integration, which should go into such an important decision.[3] This information informs the type of intraoral scanner that is best for their practice. Choosing the right intraoral scanner for the dental clinic is crucial to streamline operations and improve patient care. Various preparatory technical and clinical aspects need to be considered to choose the right intraoral scanner for clinical practice.

Choosing The Right Intraoral Scanner on clinical aspect

1. Dental Caries Detection:

Today, intraoral scanners offer many additional applications beyond digital impression acquisition, including the determination of tooth color, treatment simulation, and the monitoring of tooth movement and wear. Meanwhile, three commercially available intraoral scanners, including Trios 4 (3Shape, Copenhagen, Denmark)[2], iTero Element 5D (Align Technology, San José, CA, USA)[2], and

Planmeca Emerald S (Planmeca, Helsinki, Finland)[2], provide caries diagnostic tools for the detection of occlusal and/or proximal caries lesions integrated in their intraoral scanners intraoral scanner-based diagnostics might help to detect and monitor enamel caries lesions at an early stage to enable minimally invasive treatment options.[4]

Although bitewing radiography is described as the gold standard for proximal caries lesions, a clear disadvantage is the use of ionizing radiation, which limits the monitoring of caries lesions . Thus, bitewing radiography is not suitable for pregnant women, and should be carefully used in children. Furthermore, bitewing radiography is not helpful for the detection of early occlusal caries lesions due to the superimposition of the enamel layer.

The Diagnocam (KaVo, Biberach, Germany)[5] was developed to provide a radiation-free diagnostic method for caries diagnosis. This method is used in particular for treating children and monitoring caries lesions at short intervals owing to the absence of ionizing radiation. Meanwhile, the Diagnocam has been established in several studies as an effective diagnostic tool for the detection of proximal caries lesions, whereas data for occlusal caries diagnostics are scarce. Additionally, it must be mentioned that Diagnocam is a separate appliance that cannot be integrated into other hardware or software solutions

Considering these limitations of established caries diagnostic tools, the new intraoral scanner-based caries diagnostic tools might be a promising enhancement. Nevertheless, new diagnostic methods have to offer advantages without sacrificing diagnostic accuracy . Therefore, systematic investigations are urgently needed to confirm their efficacy.[5]

Maximiliane Amelie Schlenz et al in 2022 stated that Planmeca Emerald S demonstrated better results for occlusal caries diagnostics in permanent dentition compared to established gold standard visual examination. however, for diagnosis of occlusal caries lesions in primary dentition, the gold standard visual examination exhibited the best results. Concerning proximal caries lesions, the gold standard bitewing radiography is still not substitutable, but in permanent dentition, Planmeca Emerald S showed even better results regarding Area under the curve value than radiography. Overall, caries diagnostics with intraoral scanners seems to be an interesting tool that should be further investigated in clinical studies.

2. Implant supported prosthesis with intra oral scanners:

In recent years, rapid developments in digital technology have brought about changes in various fields. Advanced technologies such as artificial intelligence (AI) and robots have also been introduced into the medical field, and the trend is similarly widespread in the field of dentistry.

Implant-supported prosthodontics restorations require a high degree of accuracy of a virtual dental

model. Currently, the accuracy of digital impressions is comparable to conventional impressions, although the open-tray splinted impression technique is still considered clinically to be the gold standard for full-arch implant restorations (Papaspyridakos et al. 2020).[6]

The clinical application of IOS scans with simultaneous implant placement

It is necessary to adjust the emergence profile of the provisional restoration or use a customized healing abutment to create ideal mucosal contours in submerged bone-level implant treatment. With the conventional impression method, there is a risk of inflammation and contamination in the surgical area due to residual impression material if the impression is taken at the same time as implant placement. However, intraoral scanners allow for a reduction in risk, and the impression for the provisional restoration can be taken immediately after implant placement. Therefore, this technique can make the contours directly by delivering the provisional restoration with an ideal emergence profile at the time of re-entry after successful osseointegration in a submerged approach

It is then possible to wait for soft tissue maturation and duplicate the emergence contour established in the provisional restoration for the final restoration. After soft tissue maturation, the whole dentition and the surrounding mucosa are scanned. Then, the provisional restoration +is gently removed and scanned extraorally to accurately replicate and transfer the emergence profile for the final restoration (Sasada et al. 2020).[7]

Abutment disconnection and reconnection significantly affect peri-implant marginal bone levels (Koutouzis et al. 2017). Hence, it can be considered that this treatment protocol has a great advantage in that the number of times that the abutment is disconnected and reconnected can be reduced substantially. In 2012, Van der Meer et al. were the first to compare the accuracy of intraoral scanners (iTero, Lava COS®, CEREC AC, Bluecam®) in implantology. They used plaster models with partial rehabilitation using three implants and polyether ether ketone screwable scan bodies and took readings using an industrial scanner to obtain a reference model.[8]

The generation and type of intraoral scanner seem to influence the scanning precision, with some devices showing better precision in full scans than others Nevertheless, Mangano et al. found that the accuracy of digital impressions was not correlated with the resolution of the device in fully edentulous patients. Although some studies have found that digital printing is better than conventional impressions

The iTero® was found to be the best intraoral scanner, which confirmed a high stability pattern in comparison of the quality of the different readings randomized to specific clinical situations. Trueness was slightly better for total rehabilitation than for partial rehabilitation (iTero®), reflecting the great progress made by the latest generation of intraoral scanners.[9]

The advantages of the intraoral scanner as part of implant treatment include: potential cost- and time-effectiveness, Reducing the distortion of impression materials, more comfortable for patients with a sensitive gag reflex and profuse salivation, Immediate evaluation of impressions and partial re-

impression possible in the dentist's chair, easier to store and transfer digital images between the dental office and the laboratory

3. Orthodontic treatment procedure:

Digital technology started to make its way into dental and orthodontic offices with the introduction of Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) in 1973 . New inventions, such as intraoral scanning, cone beam computed tomography (CBCT), and 3D printing, have introduced the digital era in dentistry,Intraoral scanners provide the orthodontist with numerous applications, such as measurements of arch width and length, tooth size, transverse dimensions, Bolton discrepancy, overjet, and overbite, which are obtained with a remarkable accuracy and efficiency . The user can also create a digital diagnostic set-up, and simulate a proposed treatment plan, giving the opportunity to establish a more substantial relationship between patient and orthodontist.

Digital dentistry and intraoral scanners, specifically, are also transforming the relationship between the dentist and the dental laboratory.[10] Treatment ergonomics are ameliorated, since digital impressions offer a digital information flow, which will transit within the office and outwards towards patients and dental laboratories Moreover, the IOS, currently available commercially, differ in terms of accuracy and time efficiency; therefore, the contemporary devices may have wider indications for clinical use, whereas the oldest have fewer clinical indications. This is an important aspect to be considered before purchasing an IOS, in addition to other important features intraoral scanning could be the ideal method of impression taking, and the future of impressions in orthodontics. These devices offer numerous applications with a remarkable accuracy, which is constantly ameliorating from the manufacturers.[11]

They also facilitate the clinical procedure, in terms of time and comfort for both patients and dentists. Digital impressions can be used as a starting point for the realization of a whole series of customized orthodontic devices, among which, aligners seem to be the mostly used. As aligner technology constantly progresses, intraoral scanners become more and more necessary in an up-to-date orthodontic office.[12] In the coming years, it will be possible that almost all orthodontic appliances will be designed digitally with impressions from an intraoral scanner, so they will be entirely personalized and adapted to the patient's specific intraoral needs.

Some intraoral scanners used for orthodontic procedures include: iTero Element: Used for any type of treatment that requires an impression of your mouth, Primescan An intraoral scanner from Dentsply Sirona that can help create accurate clear aligner treatment plans, TRIOS: An intraoral scanner that uses confocal laser scanning to reconstruct a 3D structure.Other intraoral scanners include Aoralscan, Carestream Dental 3600, Condor, Medit i700, Cerec Primescan, Carestream CS, and iMedit 500.

4. Digital Smile Design :

Some intraoral scanners that can be used for smile design: iTero Element scanner can be used with the Invisalign system and connects to restorative and orthodontic labs. It can also be used for custom implant abutments, chairside milling, and lab CAD/CAM systems, CEREC Primescan is part of a combination with the Primemill in-office milling machine, which is designed for same-day dentistry, Straumann Virtuo Vivo comes with a high-performance laptop and surgical guide CodiagnostiX software.[13] A digital smile design software (3 Shape Dental System, 3Shape, Copenhagen, Denmark) was also used to mockup the proposed restorations based on the intraoral dental scans and the 3-D facial scans. When choosing an intraoral scanner, you can consider whether you want a closed system, which means all your technology will work together. This can simplify your workflow, but it also limits your flexibility in the future.[14]

5. Completely edentulous scenario:

The optimum function of a complete denture depends on the tight fit of the intaglio surface of the complete denture and the peripheral seal area, with the cohesive forces of saliva adding to the retention . Different impression-making techniques rely on these philosophies to record the denture-bearing area. Currently, the intraoral scanner (IOS) is a standard tool for the impression-making procedure for fixed and implant-supported prostheses with similar or better accuracy

Capturing the anatomy of an edentulous jaw with movable, pliable mucosa, a complex texture, and variable anatomy is a challenging dental procedure, scanning reduces patient discomfort as no impression material is placed
on the tissues, and the tissues are not deformed during the impression. Moreover, it allows for the easy transfer of information to the laboratory technicians and the archiving of data related to prosthesis fabricationthe fabrication of complete dentures using the IOS have suggested retraction of lips, cheek, and tongue while performing the intraoral scan. The IOS can record the tissues in a mucostatic condition; however, some difficulties can arise when recording the functional depth of the vestibule, as the IOS tip size may hinder access around the tuberosity in the posterior maxilla.[15] The feasibility of the
digital workflow, from the intraoral scanner to the fabrication of a completely retentive and functionally effective denture.

OTHER FACTORS INFLUENCING THE CHOICE OF IOS:

calibration:

Intraoral scanners vary in how much calibration they need to be functional over multiple uses. If a dentist anticipates using the scanner relatively frequently or moving it from room to room, they may choose an instrument requiring minimal calibration or one with auto calibration. Calibrating a 3D mouth scanner ensures accuracy by comparing measurements to a known reference object or points.

The goal is to ensure that the scanner accurately measures the actual size of the object it is scanning. The objective is to synchronize the scanner's data with the actual physical measurements of the object it is scanning.[1]

Calibrating an intraoral scanner involves steps and they are prepare the scanner and a calibration object following the manufacturer's instructions and then object is scanned to create a 3D image using its shape, size, and pattern as a guide and finally compare the scanned data with the known dimensions of the object to find any differences and with the data adjust the scanner's settings based on the differences to improve accuracy.

Accuracy and Speed: All scanners excel in accuracy, with variations in scanning speed.

Special Features: Each scanner offers unique features, such as AI integration (Medit i700), NIRI technology (iTero Element 5D), and smart-shade matching (Carestream CS 3700).

Integration: Consideration of compatibility with existing CAD/CAM systems and digital workflows.

Cost: Prices vary, with Medit i700 often noted for its competitive pricing among high-end scanners.

User Experience: Factors such as ease of use, ergonomic design, and training requirements are crucial for seamless integration into practice workflows.

Conclusion:

The **best intraoral scanner for a dental practice** depends on specific needs such as budget, workflow efficiency, treatment focus (restorative vs. orthodontic), and integration capabilities with existing systems. Dentists should evaluate these factors alongside the pros and cons outlined to make an informed decision that aligns with their practice goals and patient care standards.

When choosing an intraoral scanner, consider factors such as accuracy, speed, compatibility with existing systems, patient comfort, and support services offered by the manufacturer. Selecting a suitable scanner can significantly enhance clinical efficiency and patient satisfaction in your dental practice.

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