



INTRAORAL ORAL SCANNER - AN ESSENTIAL DIGITAL DEVICE FOR MODERN DAY PRACTICE: A REVIEW ARTICLE.

Dentistry

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ABSTRACT

Dentistry has undergone a revolution because To intraoral scanning, which provides a quick and painless way to take precise digital impressions of the oral cavity. This thorough analysis examines the most recent developments in intraoral scanning technology and emphasizes how they affect different dental treatments and patient care. The paper then explores the wide range of clinical uses of intraoral scanners, from prosthodontics and implantology to orthodontics and restorative dentistry. It Looks At the benefits of digital impressions over conventional techniques, such as increased accuracy, reduced chairside time, and enhanced patient comfort. Furthermore, the review explores recent innovations in intraoral scanning technology, such as the integration of artificial intelligence for automated scanning and analysis, the development of handheld scanners for increased mobility and flexibility, and the expansion of intraoral scanning capabilities to include color and texture mapping. Overall, this review provides a comprehensive overview of intraoral scanning technology, highlighting its transformative impact on modern dentistry and outlining future opportunities for innovation and improvement.

KEYWORDS

INTRODUCTION:

An intraoral scanner is a device used in dentistry to capture direct optical impressions of the dental arches, including prepared teeth and implant scan bodies. It is a handheld device that directly creates digital impression data of the oral cavity using 3D capturing technology that converts 2D images into 3D images. Intraoral scanners are used by clinicians for impression making for prepared crowns, coping cuttings, implant prosthesis, and orthodontic work. They project a light source, such as a laser or structured light, onto the object to be scanned. Intraoral scanners have advantages such as next-level ergonomics, improved hygiene, and reduced chairside impression making time. They also have disadvantages such as difficulty detecting deep margin lines of prepared teeth.^{1,2,3,4} With the more innovations in the the field of dentistry, the intraoral scanner has become the need of the hour for dental practice. The practionner should be aware of technology used in intraoral scanner, pros and cons of the scanner and precautions to be taken while using it. This article provides an insight into the above-mentioned factors.

Components of an intraoral scanner:

The components of intraoral scanner work together to capture detailed and accurate three-dimensional models of the teeth and gums, providing real-time feedback and adjustments during the scanning process.⁵

Camera: Equipped with a high-resolution camera that captures images of the teeth and gums. Advanced scanners may use multiple cameras to capture different angles simultaneously.⁵

Light Source: Most scanners use a light source, often in the form of a laser or structured light, to illuminate the oral cavity and enhance the clarity of the captured images.⁵

Touchscreen Display: Many modern intraoral scanners come with an integrated touchscreen display, allowing the dental professional to view the scans in real-time, make annotations, and even zoom in on specific areas.⁵

Software: The heart of the intraoral scanner is its software, which processes the captured images and creates the 3D model.⁵

Wireless mobile work station(optional): In addition to above components, some scanners may also have a wireless mobile workstation, a computer monitor, and other supporting equipment.⁶

Classification of intraoral scanners:

Intraoral scanners can be classified based on the scanning technology used.⁷

- Based on scanner technology, intraoral scanners based on following technology are available.

Triangulation technique: Scanner works on the principles of Triangles, hence the name Triangulation. It utilizes the principles of Trigonometry and pythogores theorem to determine the unknown object surface. The three points of Triangulation technique are

- Laser emitter(one that emits the laser light on the object surface),
- Sensor (which senses the reflected light after hitting the object surface)
- The object surface.

To obtain more detail and to prevent unnecessary light dispersion, the tooth surface might be covered by thin layer of radioopaque material (titanium dioxide, zirconium oxide with amorphous silica and aluminium hydroxide).this concept was used by CEREC system.

Confocal laser scanning: it is by means of Point-and-Stitch reconstruction of 3D image. The laser light emits through tiny pinhole to reach the desires object. The scanner then captures the light reflected from the object. Then using the 2D images from the different confocal planes, the software puts the image back into 3D (hence, the point-and-stitch part of the reconstruction). This concept was used by iTero and TRIOS.

Active wavefront sampling (3D in motion Video Recording): This technique is the sampling method behind some scanners' 3D-in-motion video recording feature. Internal sensors (complementary metal-oxide-semiconductor, or CMOS) capture 3D information from different perspectives (triple imaging). The single-lens circles around a point of interest. The pattern produced by each point gives the software distance and depth information needed to make the 3D images.⁸

- Based on the image or video technology used, such as

photographic technology scanner and video technology scanner.⁹ Photographic technology scanners take individual images of the area to be scanned, while video technology scanners record the areas to be scanned, similar to a video camera.⁹

- Intraoral scanners can also be classified based on their use, such as in-office and out-office scanners.⁹ Some of the popular brands of intraoral scanners include Trios, 3Shape, Sirona Cerec, Itero Element 2, Planmeca Emerald Scanner, 3M Tru def, and Carestream Dental 3600.^{7,10}
- Based on compatibility of scanned file, it is categorized as closed system and open system.⁶

Closed system In this system the digital file created by the intraoral scanners are in a proprietary format that only works with the software and mills or printers of same format or company. These systems offer only a specific set of clinical applications.

Open system In these systems files can be imported to any CAD software, mill and printer. The files created are saved in a commonly used format. The common file type for 3D models is ".stl" – Standard Triangulation Language. These systems offer a theoretical limitless set of indications.⁶

- Intraoral scanners can also be classified based on their configurations, such as USB scanners that can be plugged into any desktop or laptop and used, and cart-based scanners with their own specific computer hardware, monitor, and custom-built scanner cart.¹¹

Advantages and disadvantages of intraoral scanner:

Advantages :

1. Less patient discomfort¹
2. Time efficient.¹
3. Simplified clinical procedures.¹
4. No more plaster casts.¹
5. Better communication with Dental technician.¹
6. Better communication with Patient.¹
7. Improved accuracy.¹²
8. Improved efficiency.¹²
9. Sustainable.¹²
10. Better fitting restorations.¹³
11. Eco-friendly.¹³

Disadvantages:

1. Difficulty detecting deep marginal lines of prepared teeth.¹
2. Learning curve 1 and requires operator proficiency.¹³
3. Purchasing and managing costs.¹
4. Not suitable for long span bridges and removable prosthesis.¹
5. Limited acceptance by laboratories.¹²
6. Reliable internet connection is required.¹³

Factors to be considered while purchasing a scanner:

When purchasing an intraoral scanner, consider the following factors:

Image Quality: Ensure the scanner provides high-quality images for accurate diagnostics and treatment planning.⁶

Scanning Speed: A fast scanner can reduce chairside time and improve efficiency.¹⁴

Open System: Choose a scanner with an open file format accepted by various digital labs.¹⁴

Real Color 3D Images: Look for a scanner that provides real color 3D images for accurate diagnostics.¹⁴

Powder-Free Scanning: Consider a powder-free scanner to avoid the need for special contrast powder/spray and improve patient comfort.¹⁴

Long-Term Perspective: Select a scanner that will remain relevant in the future and has a small learning curve.¹⁵

Costs: Consider both the initial buying cost and any hidden costs, such as annual subscription fees, to make an informed decision.¹⁵

Support and Training: Ensure the company provides adequate support and training after the purchase.⁶

Future Capabilities: Consider potential future uses such as digital implantology, smile design, or 3D printing, and choose a scanner that enables those capabilities.⁶

Clinical Research: Review clinical studies and technical aspects to evaluate the scanner's performance and limitations.¹⁶ Purchasing an intraoral scanner is a significant investment, so it's important to carefully consider these factors to make the right choice for clinical practice.

Precautions to be taken while using intraoral scanner:

When using an intraoral scanner, several precautions should be taken to ensure accurate and effective scans. Some of the key precautions include:

Camera Obstructions: Ensure that the area to be scanned is clearly visible, as the scanner operates on the principle of "If you can't see it, you can't scan it".¹⁷

Cleanliness and Maintenance: Regularly inspect and clean the scanner's tip to avoid affecting the accuracy of the scanned image.¹⁷

Scanning Speed: Avoid spending excessive time scanning a single area, as this is often unnecessary and can lead to issues. It's better to scan at a steady pace and make any necessary adjustments as you go.¹⁷

Practice and Training: If you're new to using the scanner, practice on plastic models before using it on patients to ensure a smooth and stress-free experience.¹⁸

Dry the Teeth: Ensure that the teeth are dry before scanning, as this helps the scanner gather data more effectively. Using cotton tips or rolls can assist in drying the teeth.¹⁸

Warm Up the Tip: Allow the scanning tip to warm up adequately before beginning the scan to prevent fogging, which can affect the quality of the scan.¹⁸

Check for Distortions and Moisture: Regularly check the scan for any distortions, flattened areas, or missing information, and ensure that excess moisture is avoided to prevent scan distortion.¹⁹ By following these precautions, dental professionals can optimize the use of intraoral scanners and minimize the risk of inaccurate impressions and other scanning issues.

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