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IP Indian Journal of Conservative and Endodontics

Journal homepage: https://ijce.in/

Review Article

Intraoral scanners in dentistry: Principles, workflow, and clinical applications - A comprehensive review

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Abstract

Intraoral scanners (IOSs) have transformed digital dentistry by enabling accurate, real-time capture of intraoral structures, enhancing patient comfort, reducing clinical time, and minimizing infection risks. Their clinical utility spans prosthodontics, implantology, orthodontics, periodontics, endodontics and pedodontics. Advanced IOS systems now integrate caries detection tools, soft-tissue analysis, and AI-driven tooth segmentation, expanding their diagnostic and planning capabilities. While institutional adoption is limited by data integration challenges, IOSs continue to evolve into multifunctional platforms that optimize dental care delivery and patient communication.

Keywords: Intraoral scanner, CAD/CAM technology, Digital impression, Orthodontics

Received: 18-07-2025; **Accepted:** 30-08-2025; **Available Online**: 08-10-2025

1. Introduction

The most significant advancement in dentistry in recent years has undoubtedly been the rise of digital technologies, fundamentally transforming diagnostic and restorative workflows. In particular, intraoral scanners (IOSs) have redefined the conventional impression process by enabling accurate, real-time optical capture of dental and gingival structures directly in the patient's mouth. Their application spans prosthodontics, orthodontics, implantology, periodontics, endodontics and paediatric dentistry, offering increased patient comfort, reduced chairside time, and enhanced infection control. With the integration of computer-aided design and manufacturing (CAD-CAM) systems, clinicians can now fabricate restorations using materials like zirconia and alumina, which are unsuitable for traditional casting. More recently, the use of 3D printing and seamless data transfer to dental laboratories has eliminated the need for physical models, thereby minimising breakage risk and storage burden.[1]

The evolution of IOS technology began in the early 1970s, when Dr. François Duret introduced the concept of CAD/CAM in dentistry.[2] This vision materialized in 1987 with the introduction of the first commercial digital impression system, the CEREC® by Sirona, which allowed chairside restoration fabrication.[3] Although initially limited in precision, it laid the foundation for future innovation. A major breakthrough came in 2006 with the launch of the iTero system, enabling full-arch scanning. Its subsequent

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https://doi.org/ 10.18231/j.ijce.12422.1897150070

integration with Invisalign marked a milestone in digital orthodontics. Since then, rapid advancements by leading dental companies have led to the development of numerous scanners, with over a dozen showcased at the 2017 International Dental Show. Continued innovation promises further refinement in accuracy, speed, and clinical utility in the years ahead **(Table 1)**.[4]

The integration of IOSs with advanced imaging modalities, such as cone-beam computed tomography (CBCT) and 3D facial scanning, has significantly expanded their clinical utility. Beyond digital impressions, IOSs now contribute to comprehensive diagnostics, virtual treatment planning, surgical simulations, and post-treatment monitoring. This multimodal synergy enables more accurate assessment of hard and soft tissues, precise implant placement, and personalized prosthetic design. In orthodontics and maxillofacial surgery, such integration supports airway analysis, facial symmetry evaluation, and digital workflows for managing craniofacial anomalies. As digital ecosystems evolve, IOSs are expected to become central to fully integrated dental care, bridging diagnostics, planning, and communication within a single platform, enhancing precision, patient engagement, and interdisciplinary coordination.[5]

2. Behind the Tech: Principles of Intraoral Scanners

Despite differences in brand and design, all IOSs follow a similar basic structure: image capture, data processing, and visual display of the scan. The core difference between various IOS systems lies in how they capture the image data. There are three main imaging principles commonly used (**Figure 1**)

2.1. Confocal laser scanning

This method uses a focused laser beam projected through a small pinhole onto the tooth surface. Only the light that reflects back from the exact focal point is captured by the sensor, while out-of-focus light is ignored. This allows the system to collect a series of sharp 2D images at different depths, which are then stitched together to create a 3D model. This technique provides highly accurate data without needing to coat the teeth. Common scanners using this method include iTero and 3Shape TRIOS.[5]

2.2. Triangulation technique

Triangulation works by forming a triangle between three points: the light source, the surface of the tooth, and a sensor. By knowing the angles and distances between these points, the scanner calculates the surface's shape using basic geometry. Some scanners that use this method may require a thin layer of scanning powder (like titanium dioxide) on the teeth to reduce light reflection and improve accuracy. This technique was used in earlier systems such as CEREC.[6]

2.3. Active wave-front sampling (3D-in-Motion)

In this approach, a single camera captures images as the scanner moves, collecting 3D information based on how focused or defocused each image is. Multiple sensors inside the scanner record the object from different angles, allowing high-resolution 3D reconstruction. This method, used in devices like Lava COS and True Definition, creates a continuous video-like stream of data. A light powder dusting may be recommended in some cases to improve surface tracking.[7]

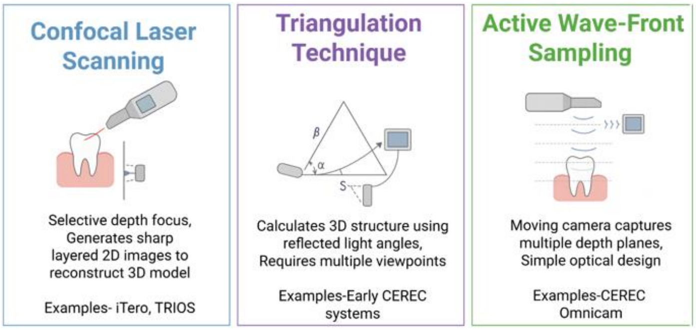

Figure 1: Principle of intra-oral scanner

Table 1: Commonly used intraoral scanners[8-10]

Scanner System	Key Features	Applications	Unique Advantages	Open/Closed System
3 Shape TRIOS	High-speed scanning, caries detection, color scanning	Prosthodontics, Orthodontics, Implantology	Wireless options, AI-powered diagnostics, patient engagement tools	Open system
iTero Element	Real-time monitoring, Invisalign integration, near-infrared imaging (NIRI) for caries detection	Orthodontics, Prosthodontics, Implantology	Seamless Invisalign ecosystem integration	Closed system (proprietary)
Medit i700 /i700 Wireless	High-resolution scanning, autoclavable tips, cloud-based collaboration	General Dentistry, Prosthodontics, Labs	Affordable, frequent software updates, open platform	Open system
Dentsply Sirona Primescan	High precision, excellent full-arch scanning, moisture handling, fast processing	Chairside restorations, Implants, Full-arch scans	Best for edentulous arches, deep margin capture	Closed system

Planmeca Emerald S	Fast, color-accurate scans, autoclavable tips, ergonomic design	Prosthodontics, Orthodontics, Surgical Planning	Lightweight, user-friendly	Open system
CEREC System (Primescan + Milling)	Integrated scanning, CAD design, and milling, same-day restorations	Prosthodontics, Implantology, Pedodontics, Periodontics	Complete chairside workflow, single-visit restoration	Closed system (proprietary)

3. Intraoral Scanning Workflow

The workflow of intraoral scanning plays a crucial role in determining the accuracy, efficiency, and clinical success of digital impressions. Understanding each step of this process is essential for both clinicians and dental technicians to fully exploit the benefits of digital dentistry. The general intraoral scanning workflow consists of the following key stages. (**Figure 2**)

3.1. Preparation

Before commencing the scanning procedure, appropriate preparation of the oral environment and scanner settings is required. This includes:

3.1.1. Powder-based scanners

Older generation intraoral scanners required the application of a thin layer of scanning powder on the dental surfaces to reduce reflectivity and enhance image capture quality. However, this step added time and complexity to the process.

3.1.2. Powder-free scanners

Modern scanners are predominantly powder-free, eliminating the need for surface coating and making the process faster and more patient-friendly. Powder-free systems have become the standard in contemporary digital impression techniques due to their ease of use and improved patient comfort.[11]

3.2. Scanning protocol

The method of scanning impacts the completeness and accuracy of the digital model. Scanning can be performed in different sequences depending on the clinical requirement:

3.2.1. Full-arch scanning

Recommended for complex prosthodontic and orthodontic procedures, this involves capturing the entire maxillary and mandibular arches.

3.2.2. Quadrant scanning

Ideal for single-unit restorations such as crowns or inlays, where only a specific section of the arch is scanned.

3.2.3. Segmental or area-specific scanning

Used when focused scanning of a small region (such as implant sites or edentulous areas) is required.

It is critical to maintain an uninterrupted and consistent scanning path while avoiding unnecessary rescans, which can introduce stitching errors or distortions in the final digital model.[12]

3.3. Bite Registration

Once both arches are scanned, an interocclusal record is obtained to capture the patient's occlusion. This step ensures proper articulation of the maxillary and mandibular digital models, which is essential for accurate prosthesis fabrication or orthodontic planning. The patient is asked to close into maximum intercuspation while the scanner captures the occlusal relationship.[13]

3.4. Data export

After completing the scan and ensuring the quality of the captured data, the digital impression is exported in suitable file formats. Commonly used file types include:

STL (Standard Tessellation Language): The most widely accepted format, suitable for most CAD/CAM applications. It contains only surface geometry data and no colour or texture information.

PLY (Polygon File Format): Includes both surface geometry and colour data, beneficial for applications requiring texture information such as shade selection or soft tissue assessment.

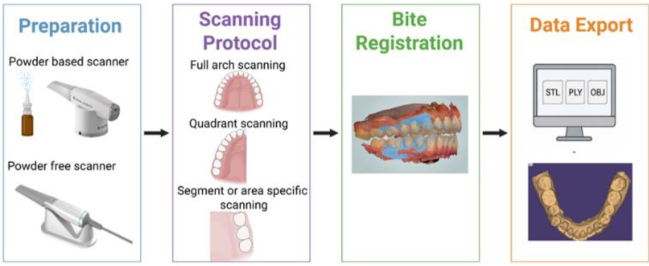

Figure 2: Intra-oral scanner workflow

OBJ (Object File Format): Similar to PLY, this format supports geometry, colour, and texture data, often used in advanced digital workflows and virtual simulations.

The exported files are then transferred to laboratory CAD software for designing restorations, orthodontic appliances, or surgical guides, thus completing the digital workflow.[12,13]

4. Applications of IOS in Orthodontics

IOS are increasingly used in orthodontics for diagnosis, treatment planning, and monitoring. Carmadella et al. noted that although digital models may have a slightly higher chance of error compared to conventional casts, systems like the Trios scanner are accurate enough to replace traditional impressions in clinical practice.[14]

Manuelli et al. compared intercanine and intermolar distances between stone models and 3D-printed casts derived from IOS scans. The measured differences were statistically significant but clinically negligible (less than 0.1 mm), confirming the reliability of IOS for orthodontic measurements.[15] Sfondrini et al. also supported the clinical use of IOS for model fabrication, diagnosis, and treatment documentation.[16]

A recent systematic review by Alassiry et al. evaluated the clinical aspects of digital three-dimensional intraoral scanning in orthodontics, focusing on parameters such as accuracy, reproducibility, scanning time, patient comfort, and operator experience. After analyzing 35 relevant studies, the review concluded that while the accuracy of IOS compared to conventional impressions remains a subject of debate, IOS showed satisfactory to excellent reproducibility. Additionally, digital scanning offers shorter chairside time and significantly improved patient comfort. The study emphasized that IOS systems are user-friendly, with an associated learning curve, and are sufficiently precise for orthodontic diagnosis, treatment planning, and the fabrication of clear aligners.[17]

Furthermore, IOS data can be integrated with CBCT and facial scans to create a comprehensive digital patient using STL, PLY/OBJ, and DICOM files. As demonstrated by Joda et al., this allows for detailed planning in orthognathic surgery, mini-screw placement, and management of ectopic teeth while reducing the need for multiple CBCT exposures, thus minimizing radiation.[18]

5. Applications of Intraoral Scanners in Prosthodontics and Implantology

IOS facilitate the fabrication of crowns, bridges, and removable prostheses by providing high-resolution digital impressions, streamlining the CAD/CAM workflow. This approach reduces chairside time, improves patient comfort, and allows for rapid, precise fabrication of prosthetic components. The ability to archive digital models also supports long-term monitoring and simplifies remakes or adjustments without requiring new physical impressions.[19]

In implant prosthodontics, IOSs are increasingly applied for capturing the position of implants via scan bodies, contributing to the accuracy of implant-supported restorations. Despite these benefits, factors such as edentulous spans, multiple implants, and angulated placements may affect scan accuracy, necessitating ongoing research and refinement of IOS protocols.[19,20] A systematic review by Rutkūnas et al. evaluated the accuracy of digital implant impressions obtained using IOS compared to conventional techniques. The analysis of 16 studies (mostly in vitro) revealed that newer generation IOS provided accuracy comparable to or better than traditional impressions for single- and multi-unit implant restorations. Factors such as implant angulation, inter-implant distance, placement depth, scanner type, scanning strategy, scanbody design, and operator experience significantly influenced accuracy outcomes. Although in vitro results were promising, the authors highlighted the need for further in vivo studies to confirm clinical reliability and to establish definitive guidelines for the use of IOS in implant prosthodontics.[21]

6. Applications of Intraoral Scanners in Periodontics

Intraoral scanners (IOS) are emerging as valuable tools in periodontics for diagnostic and monitoring purposes. A recent scoping review by Caron et al. evaluated 52 studies and reported that IOS demonstrated high accuracy in measuring gingival thickness and keratinized tissue height, especially when used in conjunction with CBCT. However, their effectiveness in plaque detection and probing depth assessment was limited due to methodological challenges and examination bias. Among the various systems, the TRIOS scanner was most frequently utilized, and software-based analyses were found to enhance data interpretation. Despite some limitations in visualizing posterior and proximal regions, IOS shows considerable promise as a diagnostic adjunct in periodontal practice, with further technological advancements expected to expand its clinical utility.[22]

Similarly, a narrative review by Strauss et al. highlighted the role of digital technologies, including IOS, in the planning, assessment, and monitoring of peri-implant soft tissue conditions. IOS, along with CBCT, intraoral ultrasonography, and spectrophotometry, has been employed to evaluate mucosal thickness, supracrestal tissue height, keratinized mucosa width, peri-implant tissue health, and aesthetic outcomes such as mucosal margin stability and color matching. These technologies improve diagnostic precision, patient comfort, and workflow efficiency. Although some methods require further clinical validation, their integration into peri-implant soft tissue management offers significant potential for enhancing both functional and aesthetic outcomes in implant dentistry.[23]

7. Intraoral Scanners in Pediatric Dentistry

IOS are emerging as valuable digital tools in pediatric dentistry, offering a more comfortable and patient-friendly alternative to conventional impression techniques. A systematic review by Serrano-Velasco et al. comprehensively evaluated the use of IOS in children, focusing on three key aspects: patient perception, chairside time, and the reliability and reproducibility of full-arch digital impressions. The review analyzed four eligible studies and found that pediatric patients consistently preferred IOS over traditional impression methods, largely due to enhanced comfort and acceptance during the scanning procedure. Although the reliability and reproducibility of IOS for capturing dental impressions were generally deemed clinically acceptable, the current evidence is limited and inconclusive, warranting more extensive research. Chairside time varied depending on the scanner model and operator experience, with some studies reporting faster procedures while others showed comparable or longer times relative to conventional methods. Overall, IOS shows promise in improving patient experience in pediatric dentistry but requires further validation to establish consistent accuracy and efficiency across different devices.[24]

Supporting these findings, a clinical study by Schulz-Weidner et al. investigated the diagnostic capabilities of two IOS systems, Trios 4 and Emerald S, for occlusal caries detection in children. The study compared these scanners with Diagnocam, a near-infrared transillumination device, and the standard visual examination based on WHO criteria. Conducted on 60 pediatric patients with an average age of approximately 9.6 years, the study revealed that Diagnocam had the highest agreement with the visual reference standard, followed closely by the Emerald S and Trios 4 scanners. While IOS demonstrated potential for visualizing occlusal caries lesions, its diagnostic accuracy was lower than traditional clinical examination methods, particularly when distinguishing enamel caries from deeper dentin involvement. Consequently, the authors recommended that IOS currently serve as an adjunct diagnostic aid rather than a standalone tool to guide treatment decisions for caries in pediatric patients.[25]

Expanding on diagnostic innovations, an in vitro study by Tashkandi et al. evaluated the iTero Element 5D IOS equipped with near-infrared irradiation (NIRI) technology for detecting proximal caries in primary teeth. This technology allows non-invasive visualization of early lesions without the use of ionizing radiation. The study compared the IOS's performance against conventional diagnostic techniques, including loupes-assisted clinical examination, bitewing radiography, and the DIAGNOcam device. Although the iTero 5D demonstrated good overall diagnostic agreement with a kappa coefficient of 0.87, its sensitivity and specificity were lower than those observed with bitewing radiographs and DIAGNOcam. The authors concluded that while NIRI-assisted IOS holds promise as a non-invasive, radiation-free tool for early caries detection in pediatric patients, further clinical validation is necessary before it can replace established diagnostic methods.[26]

8. Intraoral Scanners in Conservative Dentistry

Shade matching is a critical aspect in conservative dentistry for achieving aesthetically pleasing restorations. Visual methods, although widely used, are subjective and influenced by multiple factors such as lighting conditions and observer variability. To overcome these limitations, digital tools such as IOS and spectrophotometers have been introduced.

A clinical study evaluated and compared the reliability of visual, intraoral scanner, and spectrophotometer-based shade selection methods. Visual shade matching performed with and without a light-correcting device showed limited reliability, with Fleiss' kappa values of 0.322 and 0.177, respectively. In contrast, the IOS (TRIOS) demonstrated the highest reliability when set to the VITA 3D-MASTER scale (Fleiss' kappa = 0.874), followed closely by the spectrophotometer (VITA Easyshade Advance 4.0) using the VITA Classical scale (Fleiss' kappa = 0.805). These findings indicate that intraoral scanners can provide highly reproducible and reliable shade matching compared to conventional visual methods, underscoring their valuable application in conservative dental procedures where precision in shade selection is essential for esthetic success.[27]

In addition to shade selection, IOS have shown potential for the quantitative assessment of erosive tooth wear in conservative dentistry. Traditionally, the evaluation of enamel loss relies on noncontact profilometry; however, IOS offers a more practical, chairside alternative for clinical settings. An in vitro study systematically validated the use of IOS for detecting enamel tissue loss and compared its performance with noncontact profilometry (PRO), the gold standard. Flattened enamel surfaces on model molars underwent controlled etching procedures to simulate progressive tissue loss. IOS systems, including Trios3 and Carestream CS3600, were able to reliably detect vertical tissue loss increments as small as 10.1-17.1 µm, comparable to profilometric measurements. Statistical analysis confirmed the IOS capability to discern minor changes in enamel thickness with high agreement to PRO, as evidenced by Bland-Altmann plots, and without systematic deviation. Furthermore, IOS demonstrated reliable performance in detecting simulated cupped lesions on load-bearing cusps, expanding their applicability to complex curved tooth surfaces. The study concluded that IOS could sensitively monitor initial stages of erosive wear, suggesting their feasibility as a non-invasive, real-time diagnostic tool in preventive and restorative conservative dentistry. These findings support the integration of IOS not only for restorative purposes but also for longitudinal monitoring of tooth wear, enabling early detection and timely intervention to prevent further tissue loss.[28]

9. Advantages and Limitations of Intraoral Scanners in Dentistry

9.1. Advantages[29,30]

IOS offer several clinical and practical benefits that have revolutionized modern dental practice:

9.2. Enhanced patient comfort

IOS eliminates the need for traditional impression materials, reducing discomfort, gag reflex, and anxiety, especially beneficial for pediatric, geriatric, and special needs patients.

9.3. Time efficiency

The digital scanning process is typically faster than conventional impressions, reducing chairside time for both clinician and patient.

9.4. Integration into digital workflow

Scanned data can be seamlessly incorporated into CAD/CAM systems, allowing the production of restorations such as crowns, bridges, and aligners without the need for physical models.

9.5. Easy data storage and sharing

Digital files are easily stored, retrieved, and shared with dental laboratories or specialists worldwide, enhancing collaboration and reducing turnaround time.

9.6. Real-time visualisation

The immediate display of the scanned area allows the operator to assess the quality of the scan and correct errors instantly.

9.7. Environmentally friendly

Eliminates the need for impression materials, disinfectants, and plaster models, thus reducing waste production.

9.8. Patient Education and Communication

Scans can be shown to patients in real time to explain diagnoses and treatment plans, improving patient understanding and acceptance.

10. Limitations[29,30]

Despite the many advantages, intraoral scanners have certain constraints:

10.1. High initial investment

The purchase cost of IOS devices and associated software can be substantial, limiting accessibility for smaller or newly established practices.

10.2. Learning curve

Proper handling and technique require training and experience; incorrect usage may result in incomplete or inaccurate scans.

10.3. Challenges in subgingival and reflective surfaces

Capturing accurate scans in deep subgingival margins, highly reflective metal restorations, or areas with saliva contamination can be difficult.

10.4. Accuracy in fully edentulous arches

While IOS performs excellently in dentate or partially edentulous cases, its accuracy in capturing complete edentulous arches, where fewer anatomical landmarks are present, remains a concern.

10.5. Size and accessibility constraints

Scanner head dimensions may hinder access to posterior regions, particularly in patients with limited mouth opening.

10.6. Software compatibility and updates

Frequent software upgrades may be necessary to maintain functionality and ensure compatibility with various CAD/CAM systems, which can add to ongoing costs.

10.7. Possible technical malfunctions

As with any digital equipment, scanners may face technical glitches, calibration errors, or hardware issues that can interrupt clinical workflows.

11. Recent Advances and Innovations in Intraoral Scanners

The field of intraoral scanning technology has witnessed remarkable progress in recent years, contributing to enhanced diagnostic accuracy, streamlined workflows, and improved patient care. Key advancements include (Fig. 3)

11.1. Artificial intelligence (AI) and machine learning integration

Modern intraoral scanners are increasingly powered by AI and machine learning algorithms that assist in automating error detection, margin identification, and real-time correction of scanned data. These intelligent systems help reduce operator dependency and improve consistency and precision in the digital impressions. The integration of AI into intraoral scanning systems has shown promise in refining the quality and reliability of complete-arch digital impressions. In a recent in vitro study, Róth et al. evaluated the impact of AI specifically its ability to fill mesh defects, on the accuracy of full-arch virtual models obtained with an intraoral scanner.

Three different maxillary models representing varying clinical scenarios were scanned using a 3Shape Trios 5 scanner, both with AI assistance (AI-ON) and without AI (AI-OFF). Comparisons with reference scans indicated that while the AI-OFF mode yielded superior trueness in most measurements, the AI-ON mode significantly enhanced scan precision, especially in reducing arch distortion and deviations across the entire arch.

These findings suggest that AI-assisted scanning can improve the consistency and overall accuracy of digital impressions, particularly in complex cases where mesh defects are likely. However, further clinical research is warranted to confirm these benefits across diverse patient conditions and various IOS systems.[31]

11.2. Teledentistry: Role of intraoral scanners in remote dental care

IOS have expanded the possibilities of teledentistry by enabling seamless data exchange between dental professionals, thus supporting remote evaluations. An observational diagnostic accuracy study demonstrated that remote assessments using near-true-color intraoral images could reliably detect dental conditions. However, their effectiveness in assessing periodontal health showed variability. Enhancing image resolution and incorporating additional patient information, such as radiographs, may further improve the utility of IOS for remote screening and triage purposes in teledentistry.[32]

11.3. Integration with CAD/CAM Systems and cloud-based platforms

IOS data is now seamlessly integrated into chairside and laboratory CAD/CAM workflows, facilitating rapid design and fabrication of dental prostheses. Additionally, cloud-based platforms enable secure storage, sharing, and collaborative planning between clinicians, dental technicians, and specialists, thereby optimizing treatment efficiency and case management.[33]

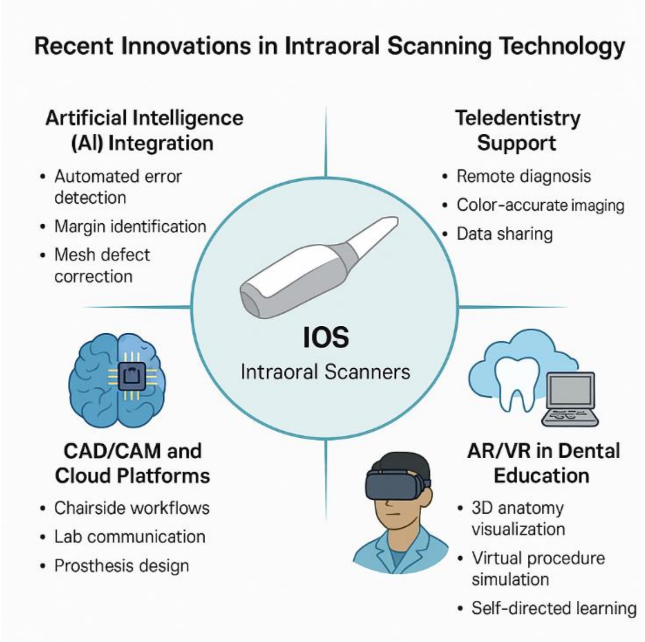

Figure 3: Recent innovations in intra-oral scanner

11.4. Augmented reality and virtual reality applications in dental education

The combination of IOS data with AR and VR technologies is transforming dental education and training. These innovations provide immersive, interactive simulations that allow students and clinicians to visualize patient-specific intraoral anatomy in 3D, practice scanning techniques, and plan complex procedures in a virtual environment, enhancing learning outcomes and clinical readiness. Liu et al. evaluated a self-directed learning model incorporating intraoral scanners for teaching tooth preparation to dental students. The study showed significant improvements in both theoretical knowledge and practical skills, with the percentage of ideal crown preparations rising from 14% to 73%. Additionally, students reported reduced anxiety and enhanced confidence. These findings highlight the potential of IOS technology to enhance skill development and independent learning in dental education.[34]

12. Discussion

The rapid evolution of IOS marks not only a technological milestone but also a fundamental shift in the philosophy of dental care. While conventional impressions emphasized material precision and operator skill, IOS reflects the growing convergence of dentistry with digital medicine, artificial intelligence, and patient-centered workflows. Beyond their technical merits, IOS represents a move toward a more integrated, accessible, and preventive model of oral healthcare.[35]

Importantly, the role of IOS extends beyond restorative and orthodontic practices. Their ability to generate interoperable data files (STL, PLY, DICOM) positions them as central to interdisciplinary collaboration, linking dentistry with radiology, maxillofacial surgery, and even medical fields such as airway management and sleep medicine. This integration strengthens the concept of a “virtual patient,” enabling comprehensive planning and simulation across specialties.[36]

From a public health perspective, IOS has the potential to reshape patient engagement and accessibility. Enhanced comfort, faster procedures, and radiation-free diagnostic adjuncts (such as near-infrared imaging) make IOS particularly beneficial for pediatric, geriatric, and special-needs populations. Moreover, the rise of teledentistry, empowered by IOS data, may help bridge gaps in access to care by allowing remote consultations and triage, a feature of growing relevance in underserved and rural regions.[24]

However, successful integration of IOS into routine practice requires consideration of cost, training, and data governance. Although initial investment is high, the reduction in remakes, elimination of storage costs, and streamlined laboratory collaboration may offset expenses over time. Furthermore, ethical aspects such as patient data privacy, interoperability of digital platforms, and long-term archiving remain underexplored but essential for the safe expansion of IOS into mainstream healthcare.[37]

Looking ahead, the next generation of IOS is likely to merge real-time diagnostics, AI-driven decision support, and cloud-based collaborative platforms. These advances will not only optimise clinical outcomes but also redefine patient-practitioner interactions, aligning dental care with broader trends in precision medicine and digital health.

13. Conclusion

Intraoral scanners (IOS) have become integral to digital dentistry, offering significant advantages in diagnostics, treatment planning, and patient comfort. Their seamless integration with CAD-CAM systems, imaging modalities, and digital workflows has transformed clinical practice, particularly in prosthodontics and orthodontics. The incorporation of artificial intelligence and machine learning further enhances their potential for accurate imaging, automated analysis, and personalized care.

However, challenges such as scanning accuracy in fully edentulous arches, cost considerations, and software usability remain. Future research should focus on improving diagnostic capabilities, expanding applications in teledentistry, and exploring integration with emerging technologies like augmented reality and robotic systems. Continuous innovation and refinement will be essential to unlock the full potential of IOS in advancing patient-centered dental care.

14. Source of Funding

None.

15. Conflict of Interest

None.

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Cite this article: Elbanna L, Singh S, Kalakota S, Genedy A, Madireddi P, Hanumanthu R, Bhola R. Intraoral scanners in dentistry: Principles, workflow, and clinical applications - A comprehensive review. *IP Indian J Conserv Endod*. 2025;10(3):146-154.