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Clinical Applications of Intraoral Scanning in Removable Prosthodontics: A Narrative Review

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Abstract: ***The advent of intraoral scanning technology has significantly impacted the field of removable prosthodontics, offering numerous benefits over traditional impression techniques. This narrative review examines the clinical applications of intraoral scanning in removable prosthodontics, highlighting its advantages, limitations, and prospects. Intraoral scanners provide high accuracy and precision, enhance patient comfort, and improve time efficiency, making them a viable alternative to conventional methods. The review explores various clinical applications, including the fabrication of full and partial dentures, relining and repair procedures, and implant-supported overdentures. Additionally, it addresses the challenges associated with intraoral scanning, such as cost, learning curve, and system compatibility. Despite these challenges, intraoral scanning technology is poised to become an integral part of prosthodontic practice, promising more predictable and patient-centered outcomes. Further research is needed to optimize scanning protocols and evaluate long-term clinical outcomes.***

Keywords: digital scanning, digital impression, digital dentistry, intraoral scanners (IOS)

1. Introduction

The recent emergence of intraoral scanning technology has transformed numerous facets of prosthodontic practice, especially within the realm of removable prosthodontics [1]. This literature review delves into the current understanding of the clinical applications of intraoral scanning in removable prosthodontics, emphasizing its benefits, drawbacks, and future outlook. Removable prosthodontics is essential for restoring oral function and aesthetics in patients with missing teeth. Traditionally, the creation of removable prostheses involves multiple steps, including the use of conventional impression materials like alginate or silicone [2,3]. While these traditional methods are well-established, they have notable limitations in terms of accuracy, patient comfort, and efficiency [4].

Intraoral scanners (IOS) have emerged as a promising alternative to traditional impression techniques, capturing highly accurate 3D digital images of the oral cavity and offering several advantages over conventional methods [5]. Research has shown that intraoral scanners produce precise digital impressions, minimizing the margin of error found in traditional impressions [6]. This high level of accuracy is essential for the proper fit and function of removable prostheses. Unlike conventional impressions, which can be uncomfortable and trigger gag reflexes, intraoral scanning is faster and less invasive, improving patient comfort and compliance [7]. The digital impressions can be immediately transferred to computer-aided design (CAD) software, streamlining the prosthetic fabrication process and resulting in shorter turnaround times for delivering removable prostheses to patients [8]. Furthermore, digital impressions can be easily shared electronically with dental laboratories or specialists, enhancing communication and collaboration in treatment planning and execution [9].

The adoption of intraoral scanning technology in removable prosthodontics has expanded across various clinical applications. Digital impressions are used to create accurate models for the fabrication of both full and partial dentures, ensuring better fit and esthetics of the prostheses [10,11]. Intraoral scanning also facilitates efficient relining or repair of existing removable prostheses by providing detailed digital impressions of the oral tissues and prosthetic bases [12]. For patients receiving implant-supported overdentures, intraoral scanning is crucial in accurately capturing implant positions and soft tissue contours to optimize prosthesis fit and stability [13]. Additionally, in cases where removable appliances are used for orthodontic treatment, intraoral scanning aids in creating precise digital models for appliance fabrication and monitoring treatment progress [14].

Despite its numerous advantages, intraoral scanning technology in removable prosthodontics faces several challenges. The initial investment in intraoral scanning equipment can be substantial, although costs are decreasing as technology advances [15]. Additionally, clinicians and dental technicians require training to effectively use intraoral scanners and integrate digital workflows into practice, presenting a significant learning curve [16]. Integration with existing CAD/CAM systems and dental laboratory workflows may also require adjustments to ensure seamless communication and data transfer. Nevertheless, the rapid evolution of intraoral scanning technology continues to redefine removable prosthodontics by enhancing precision, efficiency, and patient satisfaction [17]. Future research efforts should focus on optimizing scanning protocols, improving software capabilities, and evaluating long-term clinical outcomes of prosthetic restorations based on digital impressions [18].

2. Materials and methods

2.1 Literature Search

A comprehensive literature search was conducted to identify relevant studies on intraoral scanning in removable prosthodontics. We searched electronic databases such as PubMed, Scopus, and Google Scholar using keywords like

"intraoral scanners," "digital impressions," "removable prosthodontics," "CAD/CAM," and related terms. Articles published in English between 2011 and 2024 were specifically targeted to ensure that the review reflects the latest technological advancements.

2.2 Criteria for Inclusion and Exclusion

Studies were included if they focused on intraoral scanning techniques in removable prosthodontics, discussing their benefits, limitations, and future prospects. A variety of study types were considered, including experimental and clinical research, systematic reviews, meta-analyses, and prospective studies. Studies that primarily addressed other dental specialties or lacked sufficient data on intraoral scanning in removable prosthodontics were excluded from the review.

3. Results

Intraoral scanners (IOS) can be categorized into several types based on their technology and application. The main types of intraoral scanners include:

- Confocal Microscopy Scanners: These scanners use a confocal laser to capture images by measuring the reflection of light from the tissues. They provide high resolution and are suitable for capturing detailed surface topography [19,20].
- Optical Impression Scanners: These scanners use structured light or laser technology to create 3D images of the dental arches and oral tissues. They are known for their speed and accuracy in capturing intraoral details [21].
- Active Wavefront Sampling Scanners: These scanners use a small wand-like device that captures images through the projection of a light pattern onto the teeth and soft tissues. They are efficient in capturing both static and dynamic intraoral information [22].
- Multiscan Scanners: These scanners combine different scanning technologies, such as confocal microscopy and laser triangulation, to enhance accuracy and detail in capturing intraoral images [23].
- Real-time Scanners: These scanners provide immediate feedback and allow for adjustments during scanning to ensure comprehensive coverage and accuracy in capturing intraoral data [24].
- Video Scanners: These scanners use video cameras to capture continuous images of the oral cavity, allowing for real-time visualization and recording of intraoral structures [25].

Each type of intraoral scanner has its unique characteristics, advantages, and limitations, making it important for clinicians to choose the most suitable scanner based on their specific clinical needs and preferences [26]. Intraoral scanners have revolutionized dental impressions by offering unparalleled accuracy and precision in capturing detailed 3D images of the oral cavity. This technology significantly reduces errors associated with traditional impression materials and techniques, ensuring better fitting and more functional prosthetic restorations [27]. Moreover, intraoral scanning enhances patient comfort during the impression-taking process compared to conventional methods, which can be uncomfortable and trigger gag reflexes. The efficiency of digital impressions is another notable advantage, as scans can be immediately transferred to computer-aided design (CAD) software for prosthetic design and fabrication. This streamlines workflow processes, reduces chairside time and ultimately expedites the delivery of prostheses to patients. Real-time visualization capabilities further aid clinicians in assessing scan quality and ensuring comprehensive coverage of intraoral structures [28]. Additionally, digital impressions can be easily shared electronically with dental laboratories or specialists, facilitating improved communication and collaboration in treatment planning and execution [29].

Despite their advantages, intraoral scanners present certain challenges to dental practices. The initial investment cost for purchasing scanning equipment and software can be substantial, particularly for smaller practices or clinics. Moreover, integrating intraoral scanners with existing CAD/CAM systems and dental laboratory workflows may require adjustments to ensure seamless data transfer and compatibility, potentially disrupting established workflows [30]. Clinicians and dental technicians also face a learning curve in mastering the use of intraoral scanners and effectively integrating digital workflows into practice, which can initially impact workflow efficiency. Additionally, maintaining optimal performance of intraoral scanners through regular maintenance and software updates adds to ongoing operational costs [31]. Patient acceptance, while generally positive, can vary, as some individuals may still experience discomfort during scanning, especially those with sensitive oral tissues or a strong gag reflex [32]. These considerations highlight the need for careful evaluation and planning when adopting intraoral scanning technology in dental practice [33].

4. Conclusion

In conclusion, intraoral scanning technology represents a significant advancement in modern dentistry, particularly in the realm of prosthetic dentistry and removable prosthodontics. The technology's ability to provide highly accurate digital impressions, enhance patient comfort, streamline workflow efficiency, and improve communication with dental laboratories underscores its transformative potential. Despite initial costs and implementation challenges, the long-term benefits of intraoral scanners in terms of precision, time savings, and patient satisfaction make them a valuable investment for dental practices aiming to deliver superior prosthetic outcomes. Future research and development efforts should continue to focus on optimizing scanning protocols, enhancing software capabilities, and evaluating long-term clinical outcomes to further refine and expand the application of intraoral scanning technology in prosthodontic care. As adoption rates increase and technology continues to evolve, intraoral scanners are poised to become integral tools in achieving predictable, patient-centered prosthodontic treatments.

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