

Advantages and Challenges in Digital Impression Technology - A Narrative Review

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Abstract: Digital impression technology has become a major innovation in prosthetic dentistry, improving accuracy, efficiency, and patient comfort. This narrative review examines the current landscape of digital impressions, assessing their benefits, drawbacks, and prospects. The review underscores digital impressions' higher accuracy and precision compared to traditional methods, along with greater patient comfort and more efficient workflows. However, challenges such as high initial costs, a steep learning curve, and technical limitations remain. Additionally, better integration of digital impression systems with existing dental practice infrastructures is needed. The review also explores potential future advancements, including enhanced intraoral scanning technology, broader adoption, standardization of digital workflows, and integration with other digital dental technologies. These advancements are expected to drive widespread adoption and improve clinical outcomes in prosthetic dentistry.

Keywords: digital impressions, CAD/CAM, prosthodontics, intraoral scanners

1. Introduction

The advent of digital technology represents a pivotal moment in the field of prosthetic dentistry, fundamentally altering traditional approaches to taking dental impressions [1,2]. In contrast to conventional methods, digital impressions offer a paradigm shift characterized by enhanced precision, improved patient comfort, and streamlined workflow efficiencies. [3]. This transformative technology promises greater accuracy in capturing dental anatomy and alleviates patient discomfort associated with traditional impression materials, such as gag reflexes and extended chair time. [4]. Moreover, the efficiency gains are substantial, as digital workflows eliminate the need for physical impression materials, reduce turnaround times for prosthetic devices, and facilitate seamless communication between dental clinics and laboratories [5,6,7].

This literature review endeavors to provide a comprehensive analysis of the latest advancements and insights into digital impressions in prosthetic dentistry [8]. By delving into current research, the review aims to elucidate the tangible benefits of digital impressions while also addressing potential limitations and challenges [9,10]. Key areas of focus include the comparative accuracy of digital versus traditional methods, the economic considerations of adopting digital technology, and the ongoing technological advancements that promise to further enhance its capabilities [11]. Furthermore, the review explores the broader implications of digital impressions for clinical practice, highlighting their potential to reshape treatment protocols, improve patient outcomes, and foster interdisciplinary collaboration within the dental community [12].

By synthesizing empirical evidence and scholarly perspectives, this review aims to inform dental professionals about the transformative potential of digital impressions. It underscores the need for continued research and innovation in digital dentistry to maximize its benefits, ensure patient-centered care, and drive the evolution of prosthetic dentistry

towards more precise, efficient, and patient-friendly practices.

2. Materials and methods

2.1. Literature search

We conducted an extensive literature search to find relevant studies on digital impressions in prosthetic dentistry. We searched electronic databases such as PubMed, Scopus, and Google Scholar using keywords like "digital impressions," "intraoral scanners," "prosthetic dentistry," "CAD/CAM," and related terms. We specifically looked for articles published in English between 2010 and 2024 to ensure the information is up-to-date with current technological advancements.

2.2. Criteria for Inclusion and Exclusion

Studies were included if they specifically investigated digital impression techniques in prosthetic dentistry, covering discussions on their advantages, limitations, and future possibilities. A range of study types was considered including experimental and clinical research, systematic reviews, meta-analyses, and prospective studies. Studies that primarily focused on other dental specialties or lacked adequate data on digital impressions were excluded from our review.

3. Results

3.1 Accuracy and Precision

Digital impressions are recognized for their exceptional accuracy and precision compared to traditional methods. Research indicates that digital impressions often yield more detailed and precise data compared to traditional methods [13,14]. According to a systematic review conducted by Pappaspyridakos et al. [15], digital impressions exhibit comparable accuracy to conventional impressions in fixed prosthodontics and demonstrate superior precision in specific cases.

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3.2 Enhanced Patient Comfort

One of the primary advantages of digital impressions is the improved comfort experienced by patients [16]. Traditional impression materials can provoke discomfort, induce a gag reflex, and cause anxiety in patients [17]. In contrast, digital impressions are less intrusive, significantly reducing patient discomfort. Research by Burhardt et al. [18] highlighted that patients prefer digital impression techniques over traditional methods due to increased comfort and reduced chair time.

Efficiency and Workflow Improvement

Digital impressions streamline dental workflows by eliminating the need for physical impression materials, shipping delays to dental laboratories, and the potential for remakes due to errors in the impression process [19]. Logozzo et al. [20] observed that digital workflows contribute to overall treatment time reduction and enhance efficiency, resulting in faster turnaround times for prosthetic devices.

3.3 Enhanced Communication and Collaboration

Digital impressions facilitate improved communication between dentists and dental laboratories. These digital files are easily shareable, modifiable, and can be archived, enabling real-time collaboration and adjustments [21]. Research conducted by Guth et al. [22] highlighted that digital impressions enhance communication accuracy and efficiency between dental clinics and laboratories, thereby improving outcomes in prosthetic restorations.

3.4 Initial Cost and Learning Curve

The initial investment required for digital impression technology presents a significant barrier for many dental practices [23]. The costs associated with acquiring intraoral scanners and necessary software can be prohibitive, particularly for smaller practices. Moreover, adopting new technology entails a learning curve. According to a survey conducted by Joda et al. [24], while practitioners acknowledge the benefits of digital impressions, the substantial costs and training requirements pose notable challenges.

3.5 Technical Constraints

Despite their advantages, digital impressions are subject to certain technical limitations [25, 26]. In specific clinical scenarios, such as cases involving subgingival margins or intricate dental anatomy, intraoral scanners may encounter challenges. For instance, research conducted by Chochlidakis et al. [27] observed that while digital impressions are generally effective, they may not consistently capture fine details in complex clinical situations. This limitation has the potential to compromise the accuracy of prosthetic fittings, highlighting the ongoing need for advancements in scanner technology to address these challenges comprehensively [28].

However, challenges remain, particularly concerning the initial costs and learning curves associated with adopting digital impression technology. Technical limitations in capturing intricate clinical details also pose occasional challenges, necessitating further advancements in scanner

technology [29]. Looking ahead, ongoing developments in intraoral scanning technology, coupled with broader adoption and standardization of digital workflows, promise to address current limitations and drive wider acceptance [30]. Future research should focus on refining digital impression techniques, enhancing integration with other digital dental technologies, and optimizing cost-effectiveness to maximize the benefits for both clinicians and patients [31].

4. Conclusion

Digital impressions have transformed prosthetic dentistry with improved accuracy, patient comfort, and workflow efficiency. They match or exceed conventional methods in accuracy for fixed prosthodontics, reduce patient discomfort and chair time, and streamline communication between dental clinics and laboratories, enhancing prosthetic restoration outcomes. Despite these benefits, challenges like initial costs, learning curves, and technical limitations in capturing intricate clinical details persist. Ongoing advancements in scanner technology and workflow integration aim to address these challenges. Future research should prioritize refining digital impression techniques, optimizing cost-effectiveness, and integrating with digital dental technologies to maximize benefits for clinicians and patients, driving continual progress in prosthetic dentistry.

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