



Review Article

Revolutionising conservative dentistry: Exploring the impact and evolution of digital impression techniques in contemporary dental practice

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ABSTRACT

Digital dental impression technology has emerged as a transformative innovation in conservative dentistry, revolutionizing the process of obtaining accurate replicas of dental structures. This review explores the evolution, advantages, and implications of digital impression techniques in contemporary dental practice. From intraoral scanners to CAD/CAM technology and 3D printing, digital systems offer enhanced accuracy, efficiency, and patient comfort compared to conventional methods. Studies demonstrate the clinical acceptability and superiority of digital impressions for fabricating dental restorations and prosthetics, with reduced operation time and improved patient experience. The widespread adoption of digital technology heralds a new era in dentistry, promising streamlined workflows, superior restoration quality, and enhanced patient satisfaction. Embracing digital impression technology is essential for dental practitioners to remain at the forefront of modern dentistry and deliver optimal patient care.

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1. Introduction

The pursuit of a flawless smile continues to gain momentum, fueled by a burgeoning desire for enhanced dental aesthetics, particularly concerning color and alignment. Dental interventions not only bolster patients' confidence but also profoundly impact their personal and professional lives, albeit with a set of distinct expectations for the final outcome. Facial harmony, encompassing soft tissue, gingival esthetics, and micro and macro aesthetics, guides the quest for dental esthetics. While interdisciplinary approaches, including periodontal and orthodontic treatments, promise comprehensive improvements, they often entail lengthy healing periods and bone alterations.¹

Understanding patient preferences is paramount for successful therapy, underscoring the importance of aligning treatment with individual desires. In this pursuit, selective

enamel recontouring and direct restorations emerge as promising alternatives, offering expedited aesthetic enhancements. Selective enamel recontouring, in particular, presents a minimally invasive option, preserving dentin and minimizing postoperative sensitivity. Its simplicity, immediacy, and cost-effectiveness make it an attractive avenue for restoring natural tooth appearance and satisfying patient expectations.¹

Conservative dentistry stands at the forefront of preserving the natural integrity of teeth, prioritizing techniques that minimize intervention. Through methods such as enamel recontouring, composite resin restorations, and preventive resin restorations, the focus remains on safeguarding both the health and aesthetics of teeth. This encompasses a range of treatments, from managing deep carious lesions to pulp therapy and restoring primary molars. Central to this approach is a comprehensive analysis of risk factors, accurate caries diagnosis, and proactive preventive strategies aimed at curbing the need for

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extensive restorative interventions. The overarching goal of conservative dentistry is to deliver enduring, aesthetically pleasing outcomes while preserving as much healthy tooth structure as possible.²⁻⁶

In contemporary dental practice, digital impression techniques have emerged as a pivotal advancement, boasting several advantages over conventional methods. Notably, they promise enhanced accuracy, efficiency, and patient comfort, as evidenced by studies indicating faster impression times compared to traditional approaches.⁷ Moreover, digital impressions are increasingly favored by dental students and are anticipated to assume a dominant role in the future landscape of impression techniques.⁸ However, it's worth noting that conventional impressions retain their relevance, particularly for full-arch impressions. Nevertheless, the undeniable benefits of digital impression techniques underscore their transformative potential in revolutionizing dental practice.⁹

2. Historical Perspective of Dental Impressions

Within the realm of dental impression techniques lie two distinct methodologies: conventional and digital impressions. Conventional impressions, reliant on trays and materials like alginate, stand in contrast to digital impressions, which are acquired through intraoral scanners. Notably, digital impressions boast superior attributes, characterized by swifter, more efficient, and convenient processes compared to their conventional counterparts. With markedly shorter impression times and reduced need for adjustments, digital impressions emerge as a transformative force in modern dentistry, offering unparalleled benefits to both clinicians and patients alike.^{7,10}

The conventional landscape of dental impression techniques is fraught with inherent limitations and challenges. Employing methods like the heavy/wash technique, conventional approaches may yield undesirable outcomes, marked by increased crossarch distances and irregularities.¹¹ Furthermore, traditional techniques often fall short in capturing accurate marginal detail, plagued by issues like bubbles, tears, pits, and voids, which compromise the integrity and fit of restorations.¹² Moreover, factors such as tray rigidity and impression technique can impede the precision of traditional impressions, rendering them less reliable compared to their digital counterparts. In essence, traditional dental impression techniques may be marred by diminished accuracy and precision when juxtaposed with the advancements offered by digital impression methods.¹³

The advent of digital dental impressions represents a monumental leap forward in dental technology, revolutionizing the process of obtaining replicas of prepared teeth for restorative purposes. With unparalleled accuracy and efficiency, digital impressions are rapidly supplanting traditional elastomeric materials in dental practices worldwide. Dentists striving for excellence

in restorative dentistry aim to deliver treatments that are precise, stress-free, and streamlined. By mitigating common challenges associated with conventional techniques, digital impressions are poised to become standard practice in most dental offices in the coming years. Notably, they have demonstrated a remarkable ability to reduce remakes and returns while enhancing overall efficiency, leading to a more positive patient experience. Additionally, digital impression technology has been shown to yield more consistent laboratory products, requiring less chair time for insertion, further underscoring its transformative impact on modern dentistry.¹⁴

The emergence of digital dental impression technologies has heralded a transformative era in restorative dentistry. Intraoral scanners offer a trifecta of accuracy, efficiency, and ease, significantly reducing the need for remakes and returns while enhancing overall procedural efficiency. Research indicates that digital impressions yield restorations with superior fit, expedite seating procedures, and mitigate the occurrence of remakes when compared to conventional methods. Moreover, they afford patients a more favorable treatment experience and optimize time utilization for both practitioners and patients alike. The remarkable precision and user-friendly nature of digital impression systems have propelled their widespread adoption, particularly in the realm of dental implant restorations and other restorative interventions.^{15,16}

3. Fundamentals of Digital Impression Techniques

Digital dental impression systems comprise essential components and operate on specific principles, evolving to offer enhanced accuracy and efficiency in dental restorations. Intraoral scanners, pivotal devices in these systems, capture precise digital impressions using optical or laser technology, generating 3D models of the oral cavity. CAD/CAM technology forms the backbone, facilitating the design and fabrication of restorations like crowns and bridges based on the captured digital impressions. These systems prioritize accuracy and precision, with studies demonstrating clinically acceptable ranges of marginal gap in various procedures. Moreover, they streamline workflow, significantly reducing impression-making time in dental practices. By accommodating diverse materials and techniques, digital impression systems ensure treatment predictability, esthetic appeal, and functional accuracy in dental restorations. In essence, these systems revolutionize modern dentistry, offering comprehensive solutions that underscore accuracy, efficiency, and workflow improvement.^{17,18}

Digital dental impression systems present compelling advantages over traditional impression techniques. Notably, they exhibit comparable accuracy to conventional methods in fabricating crowns and short fixed dental prostheses. Efficiency is a standout feature, with digital techniques

showcasing faster operation times and reduced impression-making durations. Patients report enhanced comfort during procedures, experiencing less inconvenience, breathlessness, and fear of repetition. Moreover, digital impressions foster improved patient compliance and satisfaction. Preference for digital methods is evident among both students and participants, who find them easier and more preferable than traditional analog approaches. These findings underscore the transformative impact of digital impression systems on dental practice, offering streamlined workflows and enhanced patient experiences.^{7,9,19,20}

Digital dental impression systems have revolutionized the field with notable offerings such as CEREC Bluecam, CEREC Omnicam, Cadent iTero, Lava COS, Lava True Definition Scanner, 3Shape Trios, and 3Shape Trios Color. These cutting-edge technologies have demonstrated enhanced precision and efficiency in capturing dental impressions, leading to their widespread adoption across dental practices.^{17,21}

4. Applications in Conservative Dentistry

Digital impression techniques have significantly transformed the landscape of restorative dentistry, offering comparable accuracy to conventional methods in fabricating crowns and short fixed dental prostheses (FDPs), as evidenced by numerous studies. These digital techniques not only ensure clinically acceptable fit for implant-supported crowns and FDPs but also streamline the process, reducing operation time by half compared to analog methods. The implementation of digital impressions results in better-fitting restorations, quicker seating, and a reduced need for remakes. Despite these advancements, conventional methods remain preferred for full-arch impressions. Nonetheless, digital impression systems are emerging as a clinically viable alternative, enhancing both efficiency and patient experience in dental practices.^{9,15,19,22}

Digital impression techniques have sparked a revolution in endodontic practices, particularly in the realm of root canal therapy. These innovative methods offer unparalleled precision and navigation, proving invaluable in intricate cases like calcified root canals. Leveraging digital dentistry, including the utilization of 3D-printed endodontic guides, facilitates minimally invasive approaches to root canal treatments, thereby enhancing treatment outcomes and reducing the risk of iatrogenic complications. Furthermore, advancements in digital imaging modalities, such as en face optical coherence tomography (OCT), micro-computed tomography (μ CT), and scanning electron microscopy (SEM), have revolutionized the assessment of endodontic fillings' quality, enabling the detection of minute gaps as small as 50 μ m. While direct evidence on the application of digital impression techniques in endodontic procedures may be lacking, the broader strides in digital dentistry have undeniably elevated the precision and predictability of root

canal therapy.²³⁻²⁵

Digital impression techniques are pivotal in the fabrication of dental implants and prosthetics, offering notable advantages over traditional methods. Research demonstrates the accuracy of digital impressions in crafting implant-supported crowns and fixed dental prostheses (FDPs), particularly in cases involving one or two contiguous dental implants. However, conventional impressions may exhibit superior accuracy in full-arch impressions. Yet, digital impressions shine in terms of efficiency, significantly reducing operation time. In summary, digital impression techniques present a compelling alternative to conventional approaches, especially for crafting crowns and short FDPs, marking a significant stride in modern dental practice.^{9,26}

5. Clinical Considerations and Best Practices

Patient acceptance of digital impression techniques is notable, with a clear preference emerging for digital impressions over conventional methods. Evidence from a network meta-analysis indicates a substantial preference among patients for digital impressions, highlighting a preference rate of 31.23% compared to conventional techniques.²⁷ Moreover, findings from a systematic review underscore the efficiency of digital impression techniques, with shorter operation times contributing to enhanced patient satisfaction.⁹ However, it's essential to acknowledge that digital impressions may require more time compared to traditional methods. Nonetheless, the overall consensus indicates a strong inclination towards the digital workflow among patients, signaling a promising shift in dental practice.²⁸

6. Future Directions and Innovations

The evolution of digital dental impression technology heralds a transformative era in dentistry, offering a myriad of advantages. Research underscores the equivalence of digital impressions to conventional methods in fabricating crowns and fixed dental prostheses, extending to implant-supported restorations. Moreover, digital impressions not only streamline operation time but also enhance patient comfort and satisfaction. Their efficiency, coupled with reduced discomfort, marks a paradigm shift in dental practice, with studies highlighting diminished remakes and returns alongside heightened overall efficiency and patient experiences. With such advancements reshaping dental workflows, digital impressions are poised to become the cornerstone of contemporary dental care, setting a new standard in precision and patient-centricity.^{7,9,14}

The amalgamation of digital dental impression technology with CAD/CAM systems and 3D printing presents a myriad of benefits. Digital impressions offer swifter and more efficient alternatives to conventional

methods, facilitating enhanced workflow and productivity. Patients express a marked preference for digital impressions, citing reduced discomfort and apprehension during procedures. Moreover, the integration of digital technology enables the fabrication of restorations and prostheses with clinically acceptable accuracy and fit. As such, the adoption of digital technology in dentistry is swiftly gaining momentum, driven by its capacity to streamline processes and elevate patient experiences.^{7,9,19,29}

The integration of digital dental impression technology marks a significant advancement in conservative dentistry, poised to reshape clinical practices. Digital impressions offer a paradigm shift in efficiency, comfort, and convenience for patients, surpassing traditional techniques. Their clinically acceptable accuracy in fabricating dental restorations and prostheses, coupled with improved marginal fit and reduced impression-making time, heralds a new era of precision and effectiveness in dental care. Moreover, digital impressions hold promise in minimizing remakes and enhancing overall efficiency, fostering a positive patient experience. Anticipated to become standard practice in dental offices, mastering the learning curve associated with digital systems is imperative for practitioners to leverage their full potential in achieving optimal restorative outcomes.^{7,14,17,30}

7. Conclusion

In conclusion, digital dental impression technology represents a transformative breakthrough in conservative dentistry, offering unparalleled advantages over conventional methods. With its proven efficiency, patient-friendly approach, and clinically acceptable accuracy, digital impressions are poised to revolutionize dental practices worldwide. The potential to streamline processes, improve restoration quality, and enhance patient satisfaction underscores the pivotal role of digital technology in the future of dental care. As practitioners adapt to and harness the capabilities of digital systems, they stand to unlock unprecedented opportunities for delivering superior, patient-centric treatment outcomes. Embracing this technological evolution is not merely an option but a necessity for staying at the forefront of modern dentistry and ensuring the highest standards of patient care and satisfaction.

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None.

9. Conflict of Interest

None.

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