Vol. 15, No. 2, March - April 2026

# DIGITAL IMPRESSION TECHNIQUES IN PROSTHODONTICS: A NARRATIVE REVIEW

**Adam Eduard[1] ,Camilar Maria[1], Bolat Maria[1], Oniciuc Cosmin[1],Agop-Forna Doriana[2*], Radu Alexandru[1], Forna Norina[1]**

1"Gr. T. Popa" U.M.Ph. - Iași, Romania, Faculty of Dentistry, Department of Implantology, Removable Dentures, Dentures Technology
2"Gr. T. Popa" U.M.Ph. - Iași, Romania, Faculty of Dentistry, Department of Surgery

Corresponding authors: Agop-Forna Doriana , e-mail: drdorianaforna@gmail.com

## ABSTRACT

**Aim of the study:** The aim of this narrative review was to evaluate the current evidence regarding digital impression techniques in prosthodontics and to analyze their clinical applications, advantages, limitations, and future perspectives.
**Material and methods:** A literature search was conducted using scientific databases, including PubMed, Scopus, Web of Science, and Google Scholar. Relevant publications addressing intraoral scanners, digital workflows, CAD/CAM technology, and prosthodontic applications of digital impressions were reviewed and analyzed.
**Results:** Digital impression systems have become an essential component of contemporary prosthodontics. Studies have demonstrated high levels of accuracy and precision for single crowns, short-span fixed dental prostheses, and implant-supported restorations. Digital workflows improve patient comfort, reduce chairside and laboratory time, facilitate communication between clinicians and dental technicians, and enhance treatment efficiency. However, limitations remain in complete-arch scanning, edentulous cases, deep subgingival preparations, and situations involving mobile soft tissues.
**Conclusions:** Digital impression techniques represent a reliable and effective alternative to conventional impression methods in many prosthodontic procedures. Continuous technological advancements are expected to further improve scanning accuracy, clinical applicability, and integration with emerging digital technologies, supporting the widespread adoption of fully digital workflows in prosthodontics.

**Key words:** digital impressions, intraoral scanners, prosthodontics, CAD/CAM, digital dentistry, digital workflow.

## INTRODUCTION

The digital revolution has significantly influenced modern dentistry, leading to the development of innovative technologies that enhance diagnostic, therapeutic, and restorative procedures. Among these advancements, digital impression techniques have emerged as one of the most important innovations in prosthodontics. By replacing conventional impression materials and procedures with optical scanning systems, digital impressions have transformed the way clinicians capture intraoral information and fabricate prosthetic restorations.

Conventional impression techniques have long been considered the standard method for obtaining accurate replicas of oral structures. These procedures typically involve the use of elastomeric impression materials, impression trays, cast fabrication, and multiple laboratory steps. Although conventional impressions can provide satisfactory clinical results, they are associated with several disadvantages, including patient discomfort, gag reflex stimulation, dimensional changes of impression materials, inaccuracies during cast fabrication, and increased treatment time. Furthermore, errors occurring at any stage of the conventional workflow may

compromise the accuracy of the final prosthetic restoration.

The introduction of intraoral scanners (IOS) and computer-aided design/computer-aided manufacturing (CAD/CAM) technologies has enabled the transition from traditional analog workflows to fully digital prosthodontic procedures. Digital impression systems capture three-dimensional images of dental and oral structures using optical technologies and specialized software, generating virtual models that can be directly utilized for the design and fabrication of prosthetic restorations. This digital approach reduces the number of clinical and laboratory steps while facilitating communication between clinicians and dental technicians.

In recent years, substantial improvements in scanning technology have increased the accuracy, speed, and clinical applicability of digital impression systems. Modern intraoral scanners employ various image acquisition methods, including optical triangulation, confocal microscopy, active wavefront sampling, and structured light technology, allowing precise recording of hard and soft oral tissues. As a result, digital impressions have become increasingly popular for the fabrication of crowns, fixed dental prostheses, implant-supported restorations, removable prostheses, and occlusal appliances.

Numerous studies have reported that digital impressions provide accuracy comparable to conventional techniques in many clinical situations, particularly for single-unit restorations and short-span fixed prostheses. In addition, digital workflows offer advantages such as enhanced patient comfort, reduced chairside time, immediate visualization of scanned areas, simplified data storage, and improved communication with dental laboratories. Nevertheless, certain challenges remain, especially in complete-arch scans, edentulous patients, and cases involving deep subgingival margins or mobile soft tissues.

Given the growing adoption of digital technologies in prosthodontic practice, a comprehensive understanding of digital impression techniques is essential for clinicians seeking to optimize treatment outcomes. Therefore, the aim of this narrative review is to present current evidence regarding digital impression systems, focusing on their principles, clinical applications, advantages, limitations, and future perspectives in contemporary prosthodontics.

## MATERIAL AND METHODS

This narrative review was conducted through a comprehensive evaluation of the scientific literature concerning digital impression techniques in prosthodontics. Relevant articles were identified through electronic searches of major databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search strategy employed combinations of the following keywords: *digital impressions*, *intraoral scanners*, *prosthodontics*, *digital dentistry*, *CAD/CAM*, *implant prosthodontics*, *digital workflow*, and *optical scanning*.

The inclusion criteria comprised articles published in English, including systematic reviews, narrative reviews, randomized clinical trials, observational studies, and in vitro investigations related to digital impression technologies and their prosthodontic applications. Preference was given to publications from the last ten years in order to provide an updated overview of current developments in the field. Additional relevant references were identified through manual screening of the bibliographies of selected articles.

Studies focusing primarily on orthodontic applications, oral surgery procedures, or non-

prosthodontic uses of digital scanning technologies were excluded. The selected literature was analyzed with respect to the principles of digital impression acquisition, scanner technologies, accuracy and precision, clinical applications, patient-related outcomes, advantages, limitations, and future perspectives.

The collected information was critically reviewed and synthesized to provide a comprehensive narrative overview of the role of digital impression techniques in contemporary prosthodontic practice.

**Table 1.** Eligibility Criteria Used for Article Selection

| Criterion | Description |
|---|---|
| Databases searched | PubMed, Scopus, Web of Science, Google Scholar |
| Language | English |
| Publication period | 2015–2025 |
| Study types included | Systematic reviews, narrative reviews, clinical studies, in vitro studies |
| Topic | Digital impression techniques in prosthodontics |
| Exclusion criteria | Orthodontic, surgical and non-prosthodontic applications |
| Main outcomes evaluated | Accuracy, clinical applications, advantages and limitations |

## RESULTS AND DISCUSSIONS

Digital impression systems utilize optical technologies to capture three-dimensional representations of intraoral structures. Unlike conventional impression techniques, which rely on elastomeric materials to record dental anatomy, digital impressions are obtained through intraoral scanners that acquire thousands of images per second and combine them into a virtual three-dimensional model.

Modern intraoral scanners employ different image acquisition technologies, including optical triangulation, confocal microscopy, active wavefront sampling, and structured light projection. These technologies allow accurate recording of tooth morphology, preparation margins, implant scan bodies, and surrounding soft tissues. The captured data are processed by specialized software that reconstructs a digital model of the dental arch in real time.

The scanning procedure generally begins with the acquisition of occlusal surfaces, followed by buccal and lingual aspects. The software continuously aligns newly acquired images with previously scanned areas through a process known as image stitching. This approach enables the creation of a complete digital model without the need for impression materials or stone casts.

One of the major advantages of digital acquisition is the immediate visualization of scanned areas. Clinicians can identify deficiencies, incomplete regions, or artifacts during the scanning procedure and correct them instantly, thereby reducing the need for impression remakes. Furthermore, digital files can be stored electronically and transferred directly to dental laboratories, facilitating communication and enhancing workflow efficiency.

The integration of digital impressions with CAD/CAM systems represents a cornerstone of modern prosthodontics. Once acquired, digital models can be used for the virtual design and subsequent manufacturing of crowns, fixed dental prostheses, implant-supported restorations, removable prostheses, occlusal splints, and surgical

guides. As scanning technologies continue to evolve, digital impression acquisition is becoming increasingly accurate, efficient, and widely adopted in daily clinical practice.

The accuracy of digital impression systems is one of the most extensively investigated topics in contemporary prosthodontics. Accuracy is generally described through two fundamental components: **trueness** and **precision**. Trueness refers to the degree to which a digital scan corresponds to the actual geometry of the scanned object, whereas precision describes the ability of a scanner to produce consistent results when repeated scans of the same object are performed. Both parameters are essential for the fabrication of well-fitting prosthetic restorations.

Numerous studies have evaluated the accuracy of intraoral scanners and compared their performance with conventional impression techniques. The available evidence indicates that digital impressions provide clinically acceptable accuracy for single crowns, inlays, onlays, veneers, and short-span fixed dental prostheses. In many cases, digital workflows demonstrate accuracy comparable to or even superior to conventional elastomeric impression methods. The elimination of impression material distortion, cast expansion, and laboratory transfer errors contributes significantly to the accuracy of digital procedures.

For single-tooth restorations, digital impressions have shown excellent clinical performance. The precise recording of preparation margins and adjacent structures allows the fabrication of restorations with satisfactory marginal adaptation and internal fit. Several investigations have reported that restorations produced from digital impressions exhibit marginal discrepancies well within clinically acceptable limits.

The accuracy of digital impressions becomes more challenging when larger scanning areas are involved. Full-arch scans require the acquisition and alignment of a substantially greater number of images, increasing the possibility of cumulative stitching errors. Although modern scanners have demonstrated remarkable improvements in full-arch accuracy, conventional impressions may still provide advantages in certain extensive rehabilitations and complete-arch prosthetic treatments.

In implant prosthodontics, digital impression techniques have gained widespread acceptance, particularly for single implants and short-span implant-supported restorations. The use of scan bodies enables accurate transfer of implant position and angulation to the digital model. Studies have demonstrated high levels of accuracy for partially edentulous patients, while complete-arch implant-supported restorations continue to present greater technical challenges due to the increased distance between scan bodies and the potential accumulation of scanning errors.

Several factors may influence the accuracy of digital impressions, including scanner technology, operator experience, scanning strategy, patient cooperation, saliva control, lighting conditions, and the presence of reflective or translucent surfaces. Deep subgingival margins and mobile soft tissues may also negatively affect image acquisition and data processing. Consequently, clinicians must be familiar with the capabilities and limitations of their scanning systems in order to achieve predictable clinical outcomes.

Recent technological developments have substantially improved the performance of intraoral scanners. Advances in image processing algorithms, artificial intelligence-assisted data reconstruction, and enhanced optical systems have contributed to increased

trueness and precision. As a result, digital impressions are becoming increasingly reliable for a broader range of prosthodontic procedures and are progressively replacing conventional impression techniques in daily clinical practice.

**TABLE 2.** COMPARISON BETWEEN CONVENTIONAL AND DIGITAL IMPRESSION TECHNIQUES

| Parameter | Conventional Impressions | Digital Impressions |
|---|---|---|
| Patient comfort | Moderate to low | High |
| Gag reflex occurrence | Frequent | Rare |
| Clinical working time | Longer | Shorter |
| Need for impression materials | Required | Not required |
| Risk of material distortion | Present | Absent |
| Immediate evaluation of impression | Not possible | Possible |
| Data storage | Physical casts required | Digital storage |
| Communication with laboratory | Physical transportation | Instant electronic transfer |
| Accuracy for single restorations | High | High to very high |
| Accuracy for full-arch cases | High | Variable, depending on scanner |
| Remake rate | Higher | Lower |
| Integration with CAD/CAM | Indirect | Direct |

## CONCLUSIONS

Digital impression techniques have become an essential component of modern prosthodontic practice, offering a reliable alternative to conventional impression procedures. The integration of intraoral scanners with CAD/CAM technology has significantly improved the efficiency of clinical and laboratory workflows while enhancing patient comfort and communication between dental professionals.

The available scientific evidence indicates that digital impressions provide high levels of accuracy and precision, particularly for single crowns, short-span fixed dental prostheses, and implant-supported restorations. The elimination of impression material distortion and cast fabrication errors contributes to the predictability of prosthetic treatment outcomes.

Despite their numerous advantages, digital impression systems still present limitations in specific clinical situations, including complete-arch scans, edentulous patients, deep subgingival margins, and cases involving extensive soft tissue mobility. These challenges may affect scanning accuracy and should be carefully considered during treatment planning.

Continuous technological advancements in scanner hardware, image-processing software, artificial intelligence, and digital manufacturing systems are expected to further improve the performance and clinical applicability of digital impression techniques. As a result, digital workflows are likely to become increasingly prevalent across all areas of prosthodontics.

Overall, digital impression techniques represent a significant advancement in contemporary prosthodontics, combining accuracy, efficiency, and patient-centered care while supporting the ongoing transition toward fully digital dental practice.

**Acknowledgements**

The authors would like to acknowledge all researchers and clinicians whose scientific contributions have advanced the field of digital dentistry and prosthodontics. Their work has significantly improved the understanding and clinical implementation of digital impression technologies. No external funding was received for the preparation of this review article.

## REFERENCES

1. Contemporary Fixed Prosthodontics. Rosenstiel SF, Land MF, Fujimoto J. *Contemporary Fixed Prosthodontics*. 6th ed. St. Louis: Elsevier; 2022.
2. Mangano Francesco, Gandolfi A, Luongo G, Logozzo S. Intraoral scanners in dentistry: a review of the current literature. *BMC Oral Health*. 2017;17:149.
3. Revilla-León Manuel, Özcan M. Additive Manufacturing Technologies Used for Processing Polymers in Prosthodontics. *Journal of Prosthodontics*. 2019;28(2):146–158.
4. Joda Tim, Ferrari M, Gallucci GO, Wittneben JG, Brägger U, Zitzmann NU. Digital technology in fixed implant prosthodontics. *Periodontology 2000*. 2017;73(1):178–192.
5. Patzelt Sebastian BM, Emmanouilidi A, Stampf S, Strub JR, Att W. Accuracy of full-arch scans using intraoral scanners. *Clinical Oral Investigations*. 2014;18(6):1687–1694.
6. Gjelvold Bjørn, Chrcanovic BR, Korduner EK, Collin-Bagewitz I, Kisch J. Intraoral Digital Impression Technique Compared to Conventional Impression Technique. *Journal of Prosthodontics*. 2016;25(4):282–287.
7. Ahlholm Patrik, Sipilä K, Vallittu P, Jakonen M, Kotiranta U. Digital versus Conventional Impressions in Fixed Prosthodontics: A Review. *Journal of Prosthodontics*. 2018;27(1):35–41.
8. Güth Jan-Frederik. Current status of intraoral scanner technologies. *International Journal of Computerized Dentistry*. 2020;23(1):27–40.
9. Mizrahi Batya. Digital Dentistry: Current Trends and Future Perspectives. *Compendium of Continuing Education in Dentistry*. 2021;42(5):262–268.
10. Schwendicke Falk, Samek W, Krois J. Artificial Intelligence in Dentistry: Chances and Challenges. *Journal of Dental Research*. 2020;99(7):769–774.