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TRANSITION FROM CONVENTIONAL TO VIRTUAL DENTAL IMPRESSIONS: A NARRATIVE REVIEW

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ABSTRACT

Digital impression systems have become an important development in prosthodontic and orthodontic practice, offering an alternative to conventional impression techniques. This narrative review examined the literature on the clinical performance, accuracy, workflow efficiency, and patient-centered outcomes of conventional and virtual impressions. Searches were conducted in PubMed/MEDLINE, Scopus, and Google Scholar using relevant terms related to intraoral scanners, digital impressions, conventional impressions, accuracy, trueness, precision, prosthodontics, and patient-reported outcomes. The literature suggests that digital impressions are a reliable option for many routine applications, particularly single-unit and short-span restorations, where they provide clinically acceptable accuracy and clear advantages in patient comfort and workflow efficiency. Reviews of patient-reported outcomes consistently show that patients generally prefer intraoral scanning because it is associated with less discomfort and more favorable experiences related to taste, smell, sound, vibration, nausea, and queasiness. Evidence from pediatric studies similarly indicates that children often prefer digital impressions and tolerate them better than conventional methods. However, the evidence is less consistent for full-arch and other technically demanding cases, in which cumulative scanning errors may reduce accuracy and conventional impressions may remain preferable. Overall, the findings support a selective rather than universal replacement of conventional techniques. Digital impressions appear best suited to cases in which efficiency, patient experience, and digital integration are priorities, while conventional methods continue to have value when maximal precision is essential.

KEYWORDS

Digital Impressions, Intraoral Scanners, Conventional Impressions, Prosthodontics, Accuracy, Patient Comfort

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1. Introduction

The transition from conventional to virtual dental impressions reflects a broader shift in prosthodontics from material-based replication to direct digital acquisition. Intraoral scanners have improved patient comfort, reduced chairside time, and streamlined communication with dental laboratories, making them an increasingly practical option for routine restorative workflows (Bandiaky et al., 2020; Siqueira et al., 2021). In many single-unit and short-span applications, digital impressions appear comparable to conventional techniques in clinical performance, while offering clear workflow advantages (Frelich-Truchel et al., 2026; Bandiaky et al., 2020). Beyond technical performance, patient-centered outcomes have become an important part of the evidence base. Systematic reviews indicate that patients generally prefer intraoral scanning over conventional impressions because digital methods are associated with less discomfort and more favorable experiences involving smell, taste, sound, vibration, nausea, and queasiness (Christopoulou et al., 2021; de Paris Matos et al., 2021). These findings suggest that the appeal of digital impressions extends beyond efficiency to include a better patient experience.

This patient-centered advantage is especially relevant in orthodontic and pediatric care, where cooperation and tolerance may influence whether impressions can be completed successfully. In children, systematic reviews and randomized studies show that digital impressions are usually preferred and better tolerated than conventional alginate procedures, with shorter acquisition times and less gagging or discomfort (Bosoni et al., 2023; Serrano-Velasco et al., 2023). However, the evidence is less uniform in full-arch, long-span, and other technically demanding cases, where conventional impressions may still provide superior accuracy (Giachetti et al., 2020; Salgueiro et al., 2021; Pesce et al., 2024). The current challenge is therefore not whether digital impressions have a place in modern dentistry, but which clinical indications support their use most reliably.

2. Materials and methods

This narrative review was based on a structured search of the literature on conventional and virtual dental impressions. Searches were conducted in PubMed/MEDLINE, Scopus, and Google Scholar using combinations of the terms intraoral scanners, digital impressions, conventional impressions, virtual impressions, accuracy, trueness, precision, prosthodontics, patient satisfaction, and pediatric dentistry. Reference lists of relevant reviews and primary studies were also screened to identify additional papers. Studies were included if they addressed the clinical performance, accuracy, workflow efficiency, patient-centered outcomes, pediatric applications, or limitations of conventional and virtual impression techniques. The retrieved literature was organized thematically according to clinical indication, with particular attention to single-unit restorations, short-span prostheses, full-arch applications, patient-reported outcomes, and pediatric or orthodontic use. Because this was a narrative review, no formal risk-of-bias assessment or quantitative pooling was performed.

3. Results

The literature consistently suggests that intraoral scanners are a reliable alternative to conventional impressions in selected prosthodontic applications, particularly for single-unit restorations and short-span prostheses. The systematic review and meta-analysis by Bandiaky et al. (2020) found that digitally captured impressions performed comparably to conventional methods for complete-coverage, tooth-supported prostheses, while offering advantages in workflow efficiency and digital transfer to the laboratory. Similarly, Giachetti et al. (2020) concluded that digital impressions are clinically acceptable in fixed prosthodontics, especially when the restoration involves a limited arch length and a relatively straightforward clinical situation.

Patient-centered outcomes also favor digital impression workflows. Salazar et al. (2020) and Christopoulou et al. (2021) reported that patients generally preferred intraoral scanning over conventional impression procedures because of improved comfort and a more acceptable overall experience. In the review by Christopoulou et al. (2021), more positive feelings were generally observed with intraoral scanners regarding smell, taste, sound, vibration, nausea, and queasiness. Likewise, de Paris Matos et al. (2021) found that patients preferred intraoral scanning, with less discomfort and fewer negative sensations such as nausea, unpleasant taste, and breathing difficulty. These findings support the broader clinical impression that digital impressions may improve the patient experience without compromising routine restorative care in appropriately selected cases.

Evidence from implant prosthodontics points in a similar direction. Siqueira et al. (2021) found that intraoral scanning was generally faster than conventional impressions, regardless of whether quadrant or complete-arch scanning was used, and that patients generally preferred the digital workflow. A later systematic review of implant prostheses also reported shorter adjustment and impression times, as well as stronger patient preference for digital methods, while finding similar prosthetic outcomes between workflows (Ribeiro et al., 2025). Together, these findings suggest that the main advantage of digital impressions is not limited to one clinical field, but extends across restorative and implant workflows where efficiency and patient acceptance matter.

The pediatric literature is particularly consistent in its support for digital methods. Bosoni et al. (2023) reported that children aged 6 to 11 years preferred digital impressions, and that scanning was significantly faster than alginate impressions. Serrano-Velasco et al. (2023) similarly concluded that intraoral scanners in children were associated with better patient perception and comfort, although the evidence for reliability and reproducibility was less robust. A more recent randomized comparative study also found that digital intraoral scanning offered better comfort, less pain, and reduced gag reflex in pediatric patients, while maintaining comparable accuracy for several linear measurements (Patel et al., 2025). Overall, the pediatric studies suggest that digital impressions may be particularly useful when cooperation, comfort, and speed are central clinical concerns.

The evidence is less uniform for full-arch applications. Both Salgueiro et al. (2021) and Pesce et al. (2024) indicate that accuracy becomes more variable as arch length increases, and that the cumulative effect of scanning errors can reduce trueness in full-arch cases. Pesce et al. (2024) further emphasized the need for standardization in how accuracy is measured and reported, reflecting persistent heterogeneity across studies in scanning protocols, reference models, and outcome definitions. In this segment of the literature, conventional impressions still appear to retain an advantage in demanding situations where small discrepancies may be magnified across a long span.

Taken together, the results support a differentiated rather than universal role for digital impressions. The available studies point to clear clinical value in routine fixed prosthodontics, implant workflows, patient comfort, and pediatric care, but they also show that full-arch and other technically demanding indications remain the main area of uncertainty. The practical takeaway is that digital impressions are well supported for many everyday applications, while conventional techniques still have a defensible role when maximal accuracy is critical.

4. Discussion

The literature reviewed in this paper suggests that digital impressions have become a clinically useful alternative to conventional impression techniques, particularly in routine fixed prosthodontic and orthodontic applications. Across the systematic reviews included here, intraoral scanners performed well in single-unit restorations and short-span prostheses, where their accuracy appears sufficient for clinical use and their workflow advantages are most apparent. In addition to reducing material handling and chairside time, digital impressions were consistently associated with improved patient comfort and a more favorable patient experience. Taken together, these findings indicate that digital workflows are not simply a technological preference, but a practical option for many everyday restorative procedures.

A broader reading of the literature shows that the value of digital impressions is not confined to accuracy alone. Patient-reported outcome studies consistently favor intraoral scanning over conventional methods, with patients reporting less discomfort, fewer negative sensory experiences, and greater overall preference for digital procedures (Christopoulou et al., 2021; de Paris Matos et al., 2021; Siqueira et al., 2021). These patient-centered findings matter because impression-taking is not only a technical step; it is also an experience that can affect treatment acceptance, especially for patients who are sensitive to taste, nausea, breathing difficulty, or gag reflex. In this respect, digital impressions may improve both clinical efficiency and the patient's willingness to tolerate restorative care.

The pediatric evidence extends this argument further. In children, digital impressions are consistently associated with better comfort and preference, and they are often completed more quickly than conventional alginate procedures (Bosoni et al., 2023; Serrano-Velasco et al., 2023). That is clinically important because a method that is only marginally different in technical accuracy may still be preferable if it improves cooperation and reduces distress in younger patients. For pediatric orthodontic and preventive procedures, this practical advantage may be as meaningful as the technical characteristics of the scan itself. Recent comparative work also suggests that children tolerate digital methods well and may prefer them decisively over conventional impressions, even when both approaches are technically workable (Patel et al., 2025).

At the same time, the evidence shows that intraoral scanner performance is not uniform across all clinical indications. Full-arch impressions remain the most challenging application, with several reviews reporting that accuracy declines as the scanned span increases. This pattern likely reflects the cumulative effect of stitching errors and other sources of distortion that become more consequential over longer distances. As a result, the clinical advantage of digital impressions is less certain in large-span or technically demanding cases, where conventional impression techniques may still provide greater reliability. The literature therefore supports a selective rather than universal replacement of conventional impressions.

A further issue is the heterogeneity of the current evidence base. The reviews included in this paper differ in study design, outcome definitions, reference standards, and scanning protocols, which limits direct comparison across studies. Pesce et al. (2024) emphasized this problem by proposing standardization in how accuracy is analyzed and reported, underscoring the need for greater methodological consistency in future research. Without more uniform metrics for trueness and precision, it remains difficult to determine how much of the observed variation reflects scanner performance itself and how much reflects differences in study design.

From a clinical perspective, the literature supports a balanced approach. Digital impressions appear well suited to many routine prosthodontic, implant, orthodontic, and pediatric procedures, especially when efficiency, patient comfort, and digital integration are priorities. Conventional impressions, however, still have a defensible role in full-arch and other technically demanding situations where maximal accuracy is critical. Rather than viewing the two methods as competing replacements, the current evidence suggests that they are complementary tools, with the choice guided by clinical indication, required precision, patient tolerance, and operator experience.

Future research should focus on standardized protocols, larger clinical studies, and direct comparisons across specific prosthodontic and pediatric indications. Studies that stratify outcomes by arch length, restoration type, scanner generation, and age group would be especially useful, because scanner performance continues to evolve rapidly. More evidence on cost-effectiveness, learning curves, and long-term clinical outcomes would also help clarify when digital impressions provide the greatest net benefit.

5. Conclusions

Digital impressions represent a clinically valuable alternative to conventional impression techniques, particularly in routine fixed prosthodontic procedures such as single-unit and short-span restorations. The evidence reviewed in this paper indicates that intraoral scanners can provide adequate accuracy for many everyday applications while also improving patient comfort and supporting more efficient clinical workflows. These advantages make digital impressions an increasingly practical option in modern prosthodontic practice.

At the same time, the literature shows that the performance of digital impression systems is not equally strong across all clinical situations. Full-arch and other technically demanding cases remain more challenging, and conventional impression techniques may still provide greater reliability when maximum accuracy is required. For children and other patients who may struggle with conventional impression materials, digital scanning appears especially attractive because of its better acceptance, shorter procedure time, and improved comfort.

Overall, the current evidence supports a selective clinical approach in which the choice of impression technique is guided by the prosthodontic indication, the required level of precision, the patient's tolerance, and the limitations of the scanning protocol. As scanner technology continues to improve, further standardized research will be important for defining the cases in which digital impressions offer the greatest benefit.

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