

Evaluation of digital and traditional impressions in orthodontics: a narrative review

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Abstract

Objective: This narrative review explores the clinical, technical, and patient-centered differences between digital and traditional dental impression techniques, focusing on their role in orthodontics.

Background: Dental impressions are essential in orthodontic diagnostics and treatment. The introduction of digital intraoral scanners has transformed clinical workflows, offering improved patient experience and potential efficiency gains. Traditional analog methods remain valuable due to their simplicity and affordability.

Methods: A non-systematic literature review was conducted via PubMed using the keywords “digital impression,” “dental impression,” and “orthodontics.” Studies within the last 10 years that compared digital and analog methods were selected for thematic synthesis.

Results and Discussion: Digital impressions demonstrated notable benefits in terms of patient comfort, particularly for pediatric and anxious patients. Accuracy was comparable or superior to conventional methods, and digital workflows offered enhanced efficiency and data integration. However, the initial costs and learning curve for digital systems were significant. Traditional impressions, while more technique-sensitive and less comfortable, remain cost-effective and clinically adequate in many scenarios.

Conclusions: Digital and analog impression techniques each have distinct strengths and limitations. The choice should be tailored to patient needs, clinical context, and available resources. A hybrid strategy may optimize outcomes.

Keywords: digital impression, intraoral scanner, conventional impression, orthodontics, narrative review, clinical workflow, patient comfort

Introduction

Orthodontic diagnosis and treatment planning rely heavily on the precision of dental impressions. Historically, conventional analog materials such as alginate and silicone have served as the foundation for capturing dental morphology (1,2). However, recent advancements have introduced digital technologies, including intraoral scanners, offering new capabilities for clinicians (3,4).

Digital impressions promise numerous clinical and operational benefits, including improved patient comfort, reduced procedural time, and seamless integration with CAD/CAM systems (5,6). This narrative review synthesizes the current literature



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How to Cite

Sabina Saccomanno, Lorenzo Ederli Silenzi, Mario Palermi, Simone Ettore Salvati, Daniela Di Giandomenico, Eda Fani, Giuseppe Marzo.

Evaluation of digital and traditional impressions in orthodontics: a narrative review .

Annali Di Stomatologia, 16(2), 192-195.

<https://doi.org/10.59987/ads/2025.2.192-195>

comparing digital and traditional impression methods within orthodontics, examining technical performance, workflow implications, and patient-centered outcomes. The intent is to provide a balanced overview that can guide clinical decision-making.

Methods

A non-systematic literature review was performed using PubMed. The search terms included “digital impression,” “dental impression,” and “orthodontics,” connected by Boolean operators. Articles were selected based on their relevance to orthodontics, inclusion of comparative data between digital and analog methods, and discussion of clinical or patient outcomes.

Comparative Evaluation

Accuracy and Technical Reliability

Digital impressions are often reported to have equivalent or superior accuracy compared to analog methods, especially for short-span restorations and orthodontic records (7,8). These systems reduce distortion and allow direct visualization of scanned structures, minimizing retakes. Studies have evaluated trueness and precision using superimposition techniques and found that digital methods can reliably capture intraoral anatomy, especially in non-edentulous arches. However, limitations may arise in full-arch scans, edentulous patients, or cases involving subgingival margins where moisture control and scan path complexity can impact results (9). Figure 1

illustrates the workflow differences impacting technical accuracy.

Patient Comfort and Acceptance

Digital techniques eliminate the need for impression trays and materials, significantly reducing discomfort, especially for patients with strong gag reflexes, anxiety, or special needs. Data from pediatric and geriatric populations consistently show higher satisfaction with digital impressions (10,11). This is attributed not only to physical comfort but also to the perception of technological modernity. Furthermore, digital systems often allow for breaks during scanning, enhancing tolerance in longer sessions. As shown in Figure 2, digital techniques consistently report higher comfort scores across demographics.

Workflow Efficiency

Digital impressions streamline multiple steps in the orthodontic workflow: acquisition, review, refinement, and transmission. Immediate visual feedback allows clinicians to detect and correct errors on the spot, reducing retake rates and chairside time. Integration with digital design software enables faster appliance fabrication. Although some learning curve exists, especially in scan path mastery and software handling, studies report a progressive reduction in scan times with increased operator experience (13). For instance, a scan time of 5–7 minutes can replace an analog workflow that may involve over 20 minutes including material setting and model pouring (14).

Advantages	Disadvantages
Less patient discomfort	Learning curve
Ease of taking impressions in uncooperative patients	Higher costs for dentists
No more plaster casts	Difficulty detecting deep marginal lines of prepared teeth
Better communication with laboratory technician	
Better communication with patient	
Always have the documentation available	
Do not take up space but plaster models in the office	
Speed in shipping dental impressions	
Easier impressions for patients with mouth breathing ,short lingual frenulum ,gag relex	

Figure 1. Advantages and disadvantages of digital dental impression

Advantages	Disadvantages
Economic accessibility	Patient comfort
Consolidated experience	Variable precision
Compatibility	Timings
Reliability in complex cases	Perishability of the impression
Flexibility of materials	Possible errors
Ease of use	Material waste
Tactile realism	Repeatability

Figure 2. Advantages and disadvantages of digital dental impression

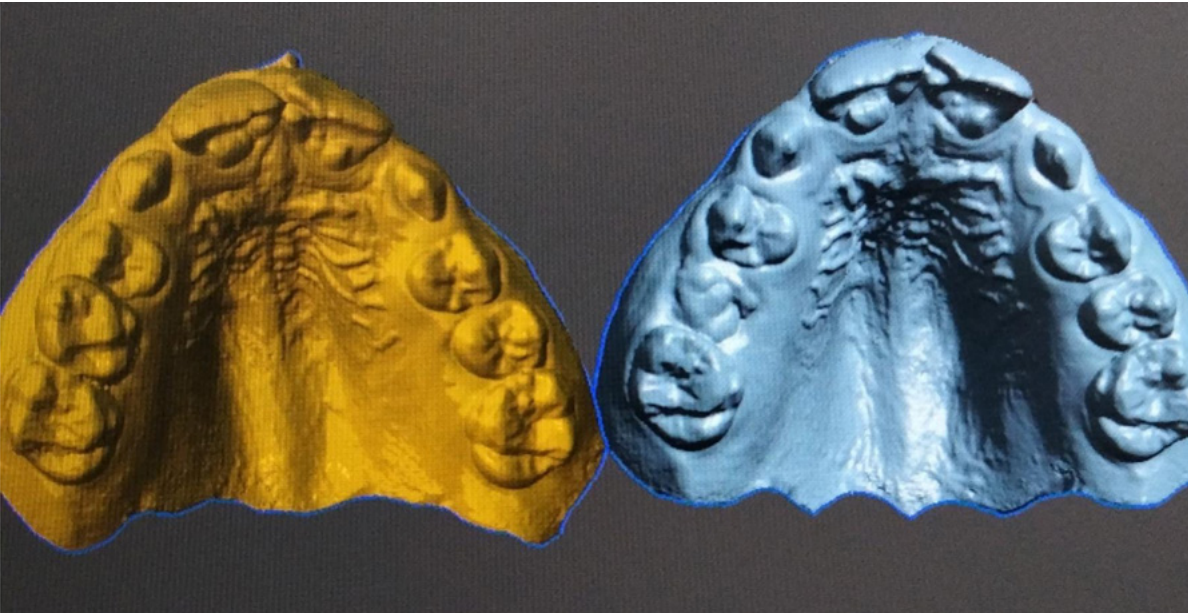


Figure 3. Upper arch of the same patient a month apart from each other

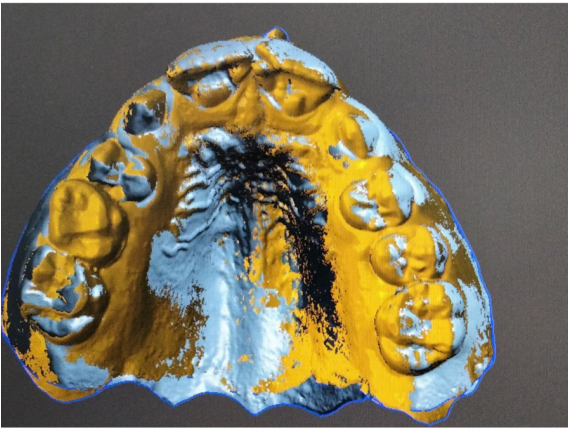


Figure 4. Superposition of the two upper arches, besides the exfoliation of element 5.4, note the details that have persisted between scans.

Economic Considerations

Initial capital investment in intraoral scanners ranges widely, from €15,000 to €40,000 depending on the brand and included features. Costs include not only hardware but also software licenses and periodic updates. However, these expenses may be amortized through reduced consumable use, lower retake rates, and time saved in daily operations. In the study by Glisic et al., cost equivalence between digital and analog workflows was reached at 3.6 years of use, assuming moderate patient volume (15). Practices with high patient turnover may realize return on investment even sooner.

Clinical Applicability

Digital impressions are increasingly used for aligner therapy, indirect bonding trays, retainers, and diagnostic

digital setups. They are particularly advantageous when frequent records or remote consultations are needed (Figures 3-4). Conversely, analog techniques may still be required in scenarios with limited access to digital tools or in complex prosthodontic reconstructions requiring physical models. Some orthodontists employ a hybrid strategy—digital for records and planning, analog for final models or when anatomical obstacles impair scan reliability (16). Table 1 summarizes key comparative findings across multiple studies.

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