



"A comparative study of conventional impressions versus intraoral scanning in prosthodontics"

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Abstract

Background: The transition from conventional to digital workflows is one of the most significant shifts in modern dentistry. This study aimed to evaluate the comparative effectiveness of traditional versus digital impression techniques, focusing on accuracy, patient experience, and workflow efficiency.

Objective: This study aims to compare conventional impression techniques with intraoral scanning using modern technologies in terms of accuracy, efficiency, patient comfort, and clinical outcomes in fixed prosthodontics and orthodontics.

Methodology: A structured questionnaire and clinical observations were conducted with a sample of 48 practitioners, including general dentists, specialists, and dental technicians with diverse field experience. Data were analyzed to identify trends in clinical adoption, economic feasibility, and technical challenges.

Results: The findings reveal a decisive professional consensus (90%) on the superior accuracy of digital methods. Digital impressions significantly reduced patient discomfort (35% of traditional method issues) and streamlined clinic-laboratory communication. Notably, 69% of participants justified the high investment costs of digital equipment through improved clinical outcomes. However, a "digital gap" was identified, as 79% of practitioners do not yet utilize specialized design software, largely due to training deficits and software costs.

Conclusion: While digital technologies are fundamentally enhancing the precision and comfort of dental procedures, their full potential remains untapped. The study emphasizes that the future of digitalization in dentistry depends not only on equipment acquisition but also on bridging the skills gap through integrated educational workshops and continuous professional training.

Keywords: digital dentistry, intraoral scanning, Conventional Impressions, Accuracy, Patient Comfort, Libya, western region, dental education.

1. Introduction

An impression in dentistry is defined as "a negative likeness or copy in reverse of the surface of an object; an imprint of the teeth and associated structures for use in dentistry," according to the *Glossary of Prosthodontic Terms* (2017). For decades, impression-taking has been a critical step in the fabrication of fixed prosthetic restorations such as crowns, bridges, inlays, onlays, and implants, as well as removable dentures (Sailer, Mühlemann et al., 2019; Rau, Olafsson et al., 2017). Conventional

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impression materials, including polyvinyl siloxane and polyether, have long been considered reliable for capturing accurate intraoral details (Bilir and Ayguzen, 2020).

Recent advances in digital dentistry have introduced intraoral scanners, which allow clinicians to obtain digital impressions directly from the patient's mouth. These systems are often reported to provide accuracy equal to or greater than conventional methods, particularly for short-span restorations and orthodontic records. Digital impressions reduce distortion, minimize the need for retakes, and enable direct visualization of scanned structures. Studies evaluating trueness and precision through superimposition techniques have confirmed that intraoral scanning can reliably capture intraoral anatomy, especially in dentate arches. However, limitations remain in full-arch scans, edentulous patients, and cases involving subgingival margins, where moisture control and scan path complexity may affect accuracy.

Orthodontics and fixed prosthodontics diagnosis and treatment planning **are critically dependent on** the precision of dental impressions. Historically, conventional analog materials such as alginate and silicone formed the foundation for capturing dental morphology. Today, intraoral scanners offer new capabilities, including improved patient comfort, reduced procedural time, and seamless integration with CAD/CAM workflows.

2. Methodology

2.1 Design and Setting of Study

This study is a descriptive cross-sectional survey that targeted dental practitioners and dental laboratory technicians operating within private dental centers and laboratories across the Western Region of Libya. Data collection was carried out during the year 2026 through a dual-track approach, involving direct field visits to various private clinical settings and the dissemination of a structured electronic questionnaire via professional networks.

2.2 Study population:

The final study sample consisted of 48 participants recruited from various private dental facilities in the **Western Region of Libya**. To ensure a multi-disciplinary evaluation of the impression techniques, the sample was distributed among **17 general dentists, 13 fixed prosthodontics, 10 orthodontics, and 8 dental laboratory technicians**. This total number of participants represents the professional pool that met the inclusion criteria and provided complete responses through both field visits and the electronic survey.

2.3 Collection of Data

A designed questionnaire was used to collect information from each participant, including professional profile, years of clinical experience, and the frequency of using digital impression technologies. Also, technical information was obtained regarding the perceived accuracy, patient comfort, and workflow efficiency of both conventional and digital methods. All gathered information was inserted into **Microsoft Excel** for further descriptive and **statistical analysis** used **SPSS statistics version 23**.

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2.4 Ethical Considerations

Ethical approval was obtained from the university's Institutional Review Board. Informed consent was secured from all participants. Confidentiality was maintained by anonymizing responses, and participation was voluntary with the option to withdraw at any time.

3. Results

Table (1): Distribution of study sample according to their professional role in dentistry

Categories	Frequency	%
General Dentist	17	35%
Orthodontist	10	21%
Fixed Prosthodontics	13	27%
Removable Prosthodontics	0	0%
Dental Technician	8	17%
Total	48	100%

Table (1): distributive the professional distribution of the study participants. **General Dentists** represented the majority of the sample at **35%**, and followed by **fixed prosthodontics** at **27%**, **orthodontics** accounted for **21%**. while **Dental Technicians** at **17%**. **Specialists** This distribution ensures a comprehensive perspective by involving the key stakeholders in the digital workflow—from clinical diagnosis to laboratory execution—thereby enhancing the reliability of the findings."

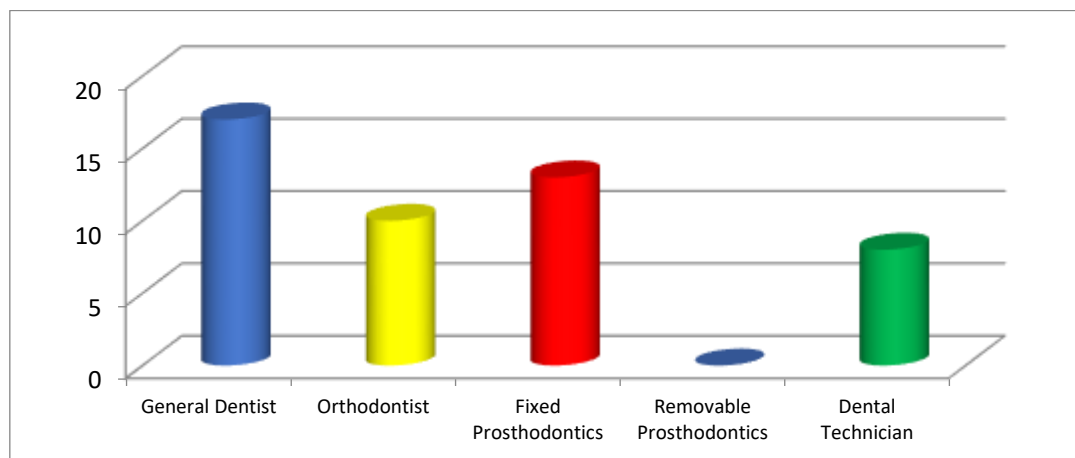


Figure 1: Distribution of study sample according to their professional role in dentistry

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Table (2): Distribution of the sample according to years of experience

Categories	Frequency	%
Less than 5 years	24	50%
years 10-5	15	31.25%
More than 10 years	9	18.75%
Total	48	100%

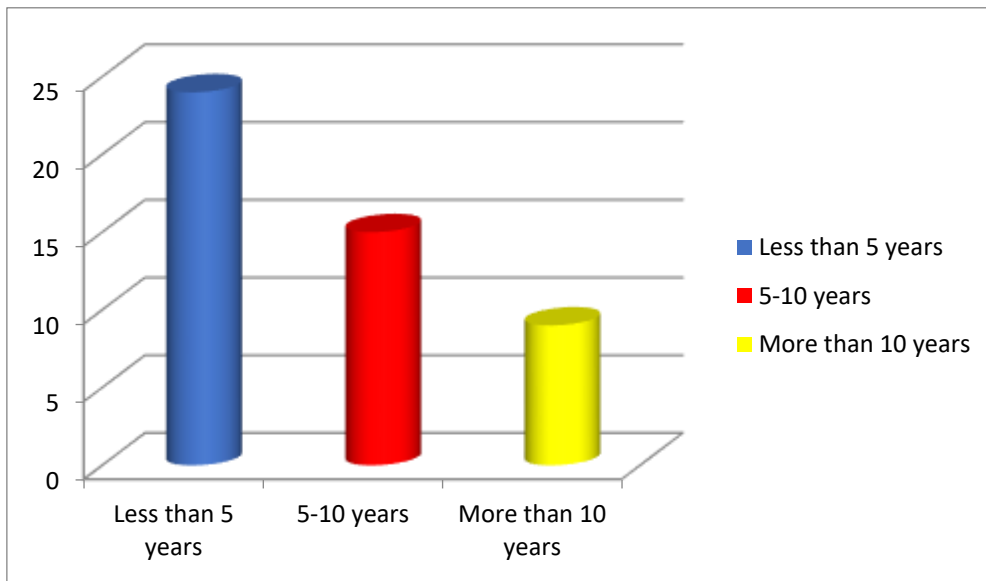


Figure 2: Distribution of the sample according to years of experience

According to Table (2) and Figure (2), which illustrate experience, the highest percentage (50%) was recorded in the (less than 5 years) age group, followed by the (5-10 years) age group, at about (31%). This indicates that most of the staff have sufficient experience to answer the statistical questions and provide appropriate results and recommendations, as well as being familiar with modern methods in the field of dentistry.

Table (3): Comparison between digital and traditional methods in terms of result accuracy.

Categories	Frequency	%
Digital is more accurate	43	90%
Traditional is more accurate	3	6%
No difference	2	4%
Total	48	100%

Table (3), which shows the accuracy of the results, shows that the highest accuracy rate was (90%) for the digital method, followed by the traditional method, which had a rate

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of (6%). This high percentage in the research sample indicates that most employees prefer the digital method of dealing with the system.

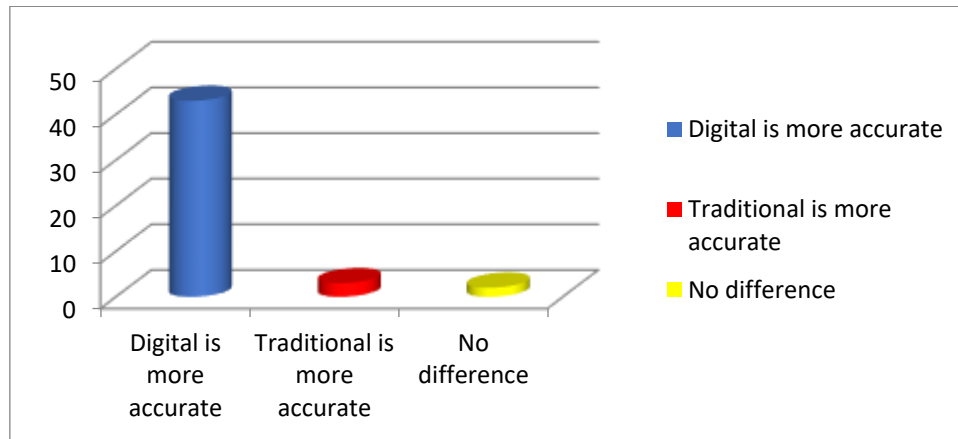


Figure 3: Comparison between digital and traditional methods in terms of result accuracy.

Table (4): Frequency of using digital technology for taking oral impressions.

Categories	Frequency	%
Rarely	6	13%
Sometimes	17	35%
Often	9	19%
Always	16	33%
Total	48	100%

From Table (4), which shows the rate of use of digital technology for taking oral impressions, we observe that the highest percentage was sometimes (35%), followed closely by (33%). This close percentage indicates a high rate of use of this technology



Figure 4: Frequency of using digital technology for taking oral impressions.

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Table (5): Common problems associated with traditional oral impression techniques.

Categories	Frequency	%
Difficulty in taking the impression	8	17%
Inaccuracy of the impression	13	27%
Negative patient reaction	17	35%
Long setting time	10	21%
Total	48	100%

Table No. (5) which shows the problems of using digital technology to take an impression of the mouth. We note that the highest percentage was for patient reaction, at (35%), followed by (27%) for the inaccuracy of the impression. This percentage indicates the low use of the traditional impression and the trend towards digital.

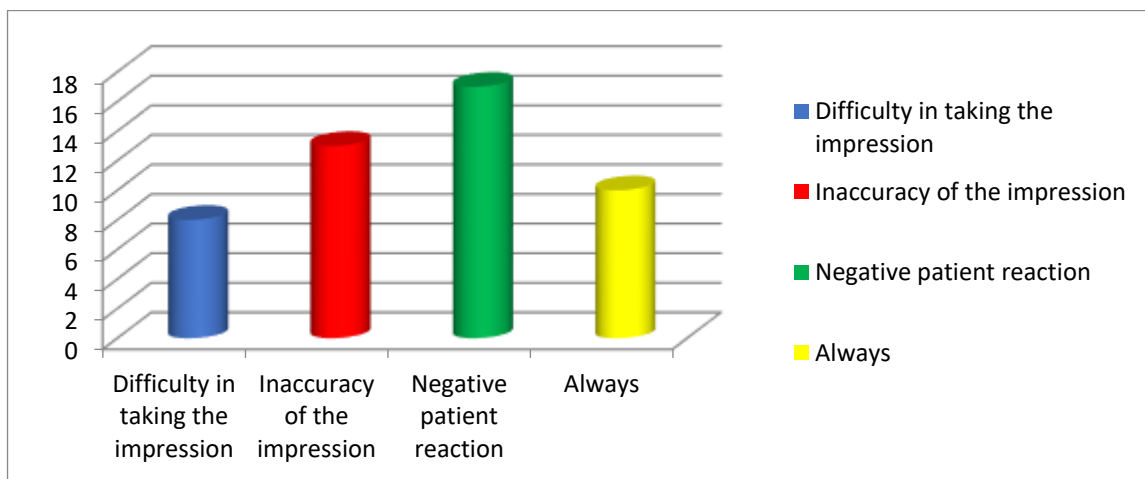


Figure 5: Common problems associated with traditional oral impression techniques.

Table (6): Participants' perspectives on the impact of cost versus benefit in decision-making.

Categories	Frequency	%
Yes, the cost is high.	10	21%
No, the benefit is worth it.	33	69%
Neutral.	5	10%
Total	48	100%

Table (6) shows the impact of cost-related decision-making. The highest percentage (69%), which is close to two-thirds of the sample, was for the patient's benefit and for dealing with the situation in the correct, safest, and most accurate way. This was followed by the second percentage (21%) for the financial aspect.

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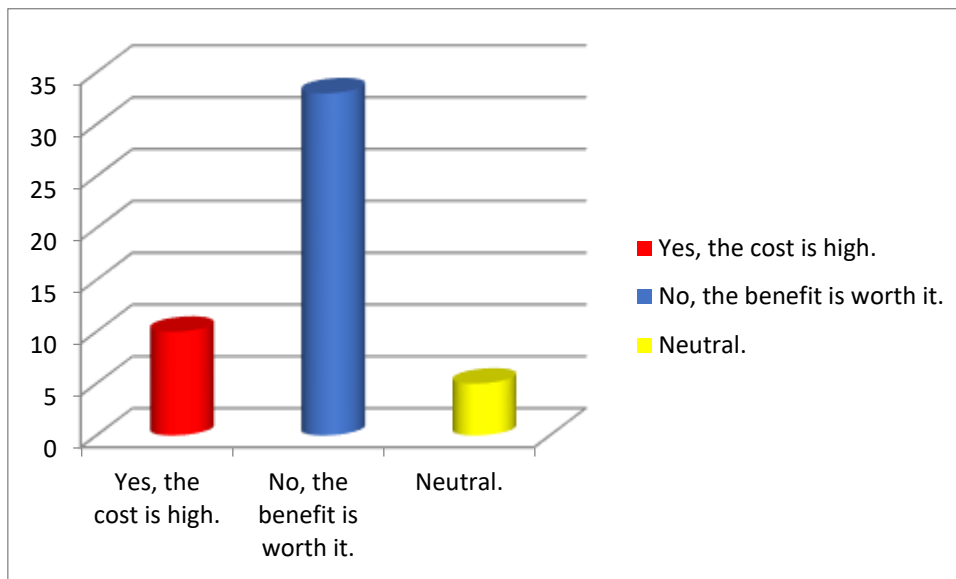


Figure 6: Participants' perspectives on the impact of cost versus benefit in decision-making.

Table (7): Use of specialized software for analyzing and designing digital impressions.

Categories	Frequency	%
Yes	10	21%
No	38	79%
Total	48	100%

Table (7), which shows the use of specific software in the printing process, indicates that the highest percentage among the sample was (no), reaching (79%). This high percentage in the research sample indicates that they have extensive experience in this field, as we mentioned previously

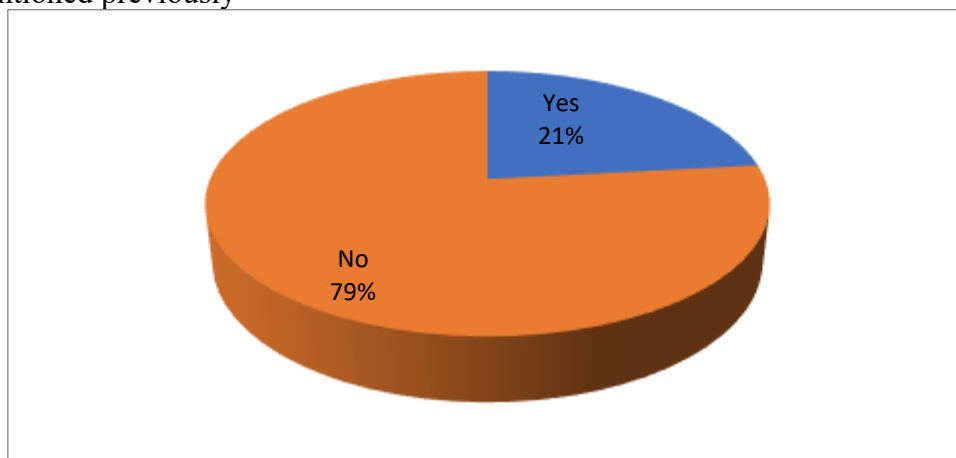


Figure 7: Use of specialized software for analyzing and designing digital impressions.

4. Discussion

This study demonstrates a clear paradigm shift toward digital workflows in dentistry, with **(90%)** of participants reporting superior accuracy compared to conventional impressions.

This finding is consistent with the literature, where digital intraoral scanning has been shown to reduce marginal discrepancies and dimensional inaccuracies associated with traditional elastomeric materials (**Papadopoulos et al., 2021**). A key driver for this transition appears to be patient experience. The **(35%)** prevalence of gag reflex with conventional trays underscores a significant barrier to patient compliance. This aligns with **Siqueira et al (Siqueira et al., 2020)**, who identified patient comfort as a critical factor in technology adoption.

Furthermore, **69%** of clinicians justified the high initial cost of digital systems by citing long-term gains in precision, safety, and efficiency.

This perception indicates a shift from viewing digital tools as an expense to viewing them as a clinical investment.

The clinical relevance of these results lies in the need to prioritize digital training in dental education to meet evolving patient expectations and clinical standards.

—far outweigh the initial costs. This indicates a professional paradigm shift where value-based care is prioritized over immediate financial expenditures (**Blatz & Conejo, 2019**).

However, a significant "digital gap" was identified in this study. Specifically, **79%** of participants reported limited engagement with specialized CAD design software. This discrepancy suggests that while clinicians have adopted digital data acquisition through intraoral scanning, many remain dependent on manual techniques or external laboratory support for the design phase.

This gap is likely attributable to two primary barriers: the high cost of software licensing and a lack of formal technical training within undergraduate and postgraduate dental curricula (**Zitzmann et al., 2020**). Clinical implications: these findings underscore an urgent need to integrate hands-on digital design workshops and specialized CAD training into dental education. Addressing this skills deficit is essential to bridge the gap between digital acquisition and digital fabrication, and to ensure the full clinical benefit of digital workflows is realized.

Another significant advantage identified was digital archiving. The "excellent" rating reported for digital storage underscores a major logistical improvement, addressing the historical challenges associated with the physical storage and degradation of plaster casts. This transition effectively streamlines collaboration between clinics and dental laboratories (**Joda et al., 2020**).

The shift from conventional to digital impressions in removable prosthodontics further reflects a broader movement toward clinical efficiency and enhanced patient comfort. Although alginate impressions using stock trays remain the most widely taught and accessible technique in dental schools, their well-documented limitations in

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dimensional stability and patient tolerance persist. Digital workflows mitigate these issues by eliminating physical materials and reducing chairside time, which may account for the higher patient satisfaction reported in comparative studies (Yuzbasioglu et al., 2014).

However, the clinical superiority of digital techniques is not absolute. Challenges remain in according mobile soft tissues and achieving functional border molding with intraoral scanners, particularly in complete denture cases where peripheral seal is critical (Schimmel et al., 2021).

This limitation may partly explain the continued preference for conventional impressions in specific clinical contexts, including many Libyan dental schools, as evidenced by recent surveys from Benghazi reporting limited exposure to CAD/CAM technologies in undergraduate training (Elafallah et al., 2024). Similarly, regional evidence indicates that while 3D-printed dentures can improve force distribution, concerns regarding material wear and tooth-bonding durability remain unresolved (Alharbi et al., 2021; Zayed et al., 2024). Therefore, the current evidence suggests that digital impression's function as a valuable adjunct rather than a complete replacement for conventional methods. The selection of techniques should remain case-dependent, with consideration of clinical indications, operator proficiency, and institutional resources.

Limitations and future directions: the present study is limited by its cross-sectional and single-country design. Future research should include multi-center curriculum analyses and long-term clinical trials to determine the optimal scenarios for integrating digital workflows into removable prosthodontics and to establish evidence-based educational standards.

5. Conclusions

This study confirms that digital technologies offer superior accuracy, enhanced patient comfort, and greater workflow efficiency compared to traditional methods. While practitioners prioritize the long-term clinical value over high initial costs, a significant gap remains in software proficiency and independent digital design. In conclusion, while digitalization is fundamentally transforming dentistry, its full potential depends on overcoming educational and financial barriers through targeted training and institutional support.

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