

Comparative Evaluation of Digital Versus Conventional Impression Techniques in Fixed Prosthodontics: Accuracy, Patient Satisfaction, and Clinical Efficiency

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ABSTRACT:

Background: Fixed prosthodontics had continuously evolved with advancements in digital dentistry, and impression-making techniques had remained a critical factor influencing the accuracy, efficiency, and overall success of prosthetic restorations. Conventional impression methods had been widely used but were often associated with patient discomfort, material-related limitations, and technique sensitivity. Digital impression techniques had emerged as an alternative approach by utilizing intraoral scanners to improve workflow, accuracy, and patient experience. However, comparative evidence regarding their clinical performance, patient satisfaction, and efficiency had remained important for optimizing prosthodontic practices.

Aim: The study had aimed to compare digital and conventional impression techniques in fixed prosthodontics by evaluating their accuracy, patient satisfaction, and clinical efficiency.

Methodology: A comparative observational study had been conducted at Services Hospital, Lahore, from May 2025 to April 2026. The study had included a total of 80 patients requiring fixed prosthodontic restorations. Participants had been divided into two groups: 40 patients had received digital impressions using an intraoral scanning system, while 40 patients had undergone conventional impressions using elastomeric impression materials. Accuracy had been assessed through marginal adaptation and dimensional consistency of the final restorations. Patient satisfaction had been evaluated using a structured questionnaire focusing on comfort, gag reflex, procedure experience, and preference. Clinical efficiency had been assessed by recording impression-taking time, number of adjustments required, and overall clinical workflow duration. Data had been analyzed to compare outcomes between both techniques.

Results: The findings had demonstrated that digital impression techniques had provided significantly improved accuracy compared with conventional methods. Restorations fabricated using digital impressions had shown better marginal fit and fewer discrepancies. Patients in the digital impression group had reported higher satisfaction levels due to reduced discomfort, shorter procedural duration, and improved overall experience. The average impression-taking time had been lower in the digital group compared with the conventional group. Furthermore, digital workflows had required fewer repeat impressions and fewer chairside adjustments during restoration placement. Conventional impressions had remained clinically acceptable but had been associated with increased patient discomfort, longer processing time, and greater technique sensitivity.

Conclusion: The study had concluded that digital impression techniques had demonstrated superior accuracy, enhanced patient satisfaction, and improved clinical efficiency compared with conventional

impression methods in fixed prosthodontics. Digital impressions had provided a more comfortable and streamlined approach while maintaining reliable restorative outcomes. The findings had suggested that incorporation of digital technologies had improved the quality and effectiveness of prosthodontic treatment procedures.

Keywords: Digital impression, Conventional impression, Fixed prosthodontics, Intraoral scanning, Accuracy, Patient satisfaction, Clinical efficiency, Restorative dentistry.

INTRODUCTION:

Fixed prosthodontics had remained an essential component of restorative dentistry, focusing on the rehabilitation of damaged, missing, or compromised teeth through the placement of crowns, bridges, and other fixed dental prostheses. The success of fixed prosthodontic treatments had depended greatly on accurate impression procedures, as precise replication of intraoral structures had been necessary for achieving proper marginal adaptation, occlusal harmony, esthetics, and long-term restoration durability [1]. Traditionally, conventional impression techniques using elastomeric materials such as polyvinyl siloxane and polyether had been widely practiced due to their reliability and established clinical outcomes. However, these methods had been associated with several limitations, including patient discomfort, gag reflex stimulation, dimensional changes of impression materials, risk of distortion during handling, and increased laboratory processing time.

With the advancement of digital dentistry, intraoral scanning technology had emerged as a modern alternative to conventional impression methods [2]. Digital impression techniques had utilized optical scanning devices to capture three-dimensional images of intraoral structures, allowing direct transfer of digital data to computer-aided design and manufacturing (CAD/CAM) systems. This technological development had transformed fixed prosthodontic workflows by improving communication between clinicians and dental laboratories, reducing manual errors, and facilitating efficient fabrication of restorations. Digital impressions had also provided advantages such as immediate visualization of scanned areas, easier correction of errors, elimination of impression materials, and enhanced patient comfort [3]. Accuracy had been considered one of the most critical factors influencing the clinical success of fixed prosthodontic restorations. Conventional impressions had depended on multiple factors, including tray selection, material manipulation, setting time, removal technique, and storage conditions, which had potentially affected the final accuracy of the cast and restoration. In contrast, digital impressions had relied on advanced scanning technology that had captured detailed surface information and produced highly accurate virtual models [4]. Nevertheless, the accuracy of digital systems had varied depending on scanner type, operator experience, scanning strategy, and clinical conditions such as saliva control, preparation design, and accessibility of the treatment area. Therefore, comparative evaluation of both techniques had been important to determine their effectiveness in routine prosthodontic practice.

Patient satisfaction had become an increasingly important outcome measure in modern dentistry. Conventional impression procedures had often caused anxiety and discomfort among patients due to the presence of bulky trays, unpleasant taste of impression materials, and prolonged intraoral procedures. Digital scanning had been reported to provide a more comfortable and acceptable experience because it had reduced the need for impression materials and shortened chairside procedures [5]. However, factors such as treatment complexity, patient expectations, and familiarity with digital technology had influenced overall satisfaction levels.

Clinical efficiency had also played a significant role in determining the preferred impression technique. Conventional methods had required multiple clinical and laboratory steps, including impression making, disinfection, pouring of casts, and manual fabrication procedures. Digital impression systems had streamlined these processes by allowing rapid data acquisition, electronic transfer, and integration with CAD/CAM workflows. Despite these benefits, challenges such as high equipment costs, maintenance

requirements, and the need for specialized training had limited the widespread adoption of digital techniques in some clinical settings [6].

Previous investigations had demonstrated varying outcomes regarding the superiority of digital or conventional impression methods. While several studies had reported improved patient comfort and comparable or enhanced accuracy with digital impressions, others had suggested that conventional techniques remained dependable, particularly in complex cases involving multiple units or subgingival margins [7]. These differences had highlighted the need for continued evaluation of both approaches under clinical conditions.

Therefore, the comparative assessment of digital versus conventional impression techniques in fixed prosthodontics had been essential to understand their relative advantages and limitations. Evaluating parameters such as accuracy, patient satisfaction, and clinical efficiency had provided valuable insights into selecting the most appropriate impression method for achieving predictable prosthodontic outcomes. This study had aimed to compare these two impression approaches and determine their effectiveness in improving restorative accuracy, patient experience, and overall clinical performance [8].

MATERIALS AND METHODS:

This comparative evaluation study was conducted at the Department of Prosthodontics, Services Hospital, Lahore, from May 2025 to April 2026. The study was designed to assess and compare the clinical performance of digital and conventional impression techniques used in fixed prosthodontics, with particular emphasis on impression accuracy, patient satisfaction, and clinical efficiency. A total of 80 patients requiring fixed prosthodontic restorations, including crowns and fixed partial dentures, were enrolled in the study. The participants were selected according to predefined inclusion and exclusion criteria to ensure appropriate representation of cases suitable for both impression techniques.

Patients included in the study were adults requiring single-unit crowns or short-span fixed dental prostheses with healthy periodontal tissues and adequate oral hygiene. Individuals with severe periodontal disease, extensive tooth mobility, uncontrolled systemic disorders, or conditions affecting impression accuracy were excluded. Written informed consent was obtained from all participants after explaining the study objectives, procedures, benefits, and possible limitations. Ethical approval for the study was obtained from the relevant institutional review committee of Services Hospital, Lahore.

The enrolled patients were randomly divided into two equal groups, with 40 participants allocated to the digital impression group and 40 participants allocated to the conventional impression group. In the digital impression group, intraoral scanning was performed using a digital intraoral scanner to capture the prepared tooth and surrounding oral structures. The scanning procedure was carried out according to the manufacturer's recommended protocol, ensuring complete visualization of the preparation margins, occlusal surfaces, and adjacent teeth. The digital impressions were processed using computer-aided design (CAD) software, and virtual models were generated for fabrication of the final prosthetic restorations.

In the conventional impression group, traditional impression techniques were performed using elastomeric impression materials. After appropriate tooth preparation and gingival tissue management, impressions were recorded using custom or stock trays according to clinical requirements. The impressions were evaluated for accuracy, completeness, and reproduction of preparation details before being sent for laboratory processing. Stone casts were fabricated from conventional impressions, and restorations were designed and produced using standard laboratory procedures.

The primary outcome measure was impression accuracy, which was evaluated by assessing the marginal fit, dimensional accuracy, and adaptation of the fabricated restorations. The accuracy of digital and conventional techniques was compared through clinical examination and laboratory assessment of the final prostheses. Secondary outcomes included patient satisfaction and clinical efficiency. Patient satisfaction was assessed using a structured questionnaire that evaluated comfort, gag reflex response, procedure

acceptability, and overall experience during impression recording. Clinical efficiency was assessed by recording the total chairside time required for impression procedures, including preparation, impression acquisition, and correction of errors.

Data collection was performed using standardized assessment forms. Demographic characteristics, clinical findings, type of restoration, impression procedure details, and outcome measurements were documented for each participant. The collected data were analyzed statistically to determine differences between the digital and conventional impression groups. Continuous variables such as impression time and accuracy scores were presented as mean values with standard deviations, while categorical variables such as patient satisfaction levels and restoration outcomes were expressed as frequencies and percentages.

Statistical analysis was performed using appropriate statistical tests. The independent sample t-test was used for comparison of continuous variables between the two groups, while the chi-square test was applied for categorical variables. A p-value of less than 0.05 was considered statistically significant. The results were interpreted to determine whether digital impression techniques provided superior accuracy, improved patient satisfaction, and greater clinical efficiency compared with conventional impression methods in fixed prosthodontic procedures.

All procedures were performed under standardized clinical conditions by trained dental professionals to minimize operator-related variability. Quality control measures were maintained throughout the study period to ensure reliability and consistency of collected data. The methodology allowed a comprehensive comparison of both impression techniques and provided evidence regarding their effectiveness in routine fixed prosthodontic practice.

RESULTS:

A total of 80 patients requiring fixed prosthodontic restorations were included and divided equally into two groups. Group A underwent digital impression techniques, while Group B received conventional elastomeric impressions. The outcomes were evaluated in terms of accuracy, patient satisfaction, and clinical efficiency.

Table 1: Comparison of Accuracy Outcomes Between Digital and Conventional Impression Techniques:

Parameter	Digital Impression (n=40)	Conventional Impression (n=40)	p-value
Marginal discrepancy (μm)	34.8 ± 9.6	76.2 ± 14.8	<0.001
Internal fit error (μm)	51.3 ± 11.4	92.7 ± 17.9	<0.001
Prosthesis remake rate (%)	5% (2/40)	20% (8/40)	0.04

Table 2: Comparison of Patient Satisfaction and Clinical Efficiency:

Parameter	Digital Impression (n=40)	Conventional Impression (n=40)	p-value
Patient satisfaction score (out of 10)	8.9 ± 0.6	7.1 ± 0.8	<0.001
Impression procedure time (minutes)	6.2 ± 1.8	12.4 ± 3.1	<0.001
Chairside adjustment time (minutes)	8.5 ± 2.7	15.3 ± 4.2	<0.001
Gag reflex incidence (%)	10% (4/40)	35% (14/40)	0.01
Operator-reported ease of procedure (%)	87.5%	32.5%	<0.001

The present study evaluated and compared digital and conventional impression techniques in fixed prosthodontics with respect to accuracy, patient satisfaction, and clinical efficiency. A total of 80 patients were analyzed, equally divided into two groups of 40 participants each. The findings demonstrated a consistent advantage of digital impressions over conventional methods across most evaluated parameters. In terms of accuracy outcomes (Table 1), digital impressions showed significantly superior results. The mean marginal discrepancy in the digital group was recorded at $34.8 \pm 9.6 \mu\text{m}$, whereas the conventional group demonstrated a considerably higher discrepancy of $76.2 \pm 14.8 \mu\text{m}$. This difference was statistically significant ($p < 0.001$), indicating improved marginal adaptation in restorations fabricated using digital workflows. Similarly, internal fit error was notably lower in the digital group ($51.3 \pm 11.4 \mu\text{m}$) compared to the conventional group ($92.7 \pm 17.9 \mu\text{m}$), further confirming enhanced precision with intraoral scanning technology. The reduced distortion associated with digital impressions contributed to better reproduction of intraoral structures and improved prosthesis fit.

The prosthesis remake rate also reflected this trend, with only 5% of cases in the digital group requiring remakes compared to 20% in the conventional group. This finding highlighted the clinical reliability of digital impressions and their potential to reduce laboratory errors and rework, thereby improving overall treatment efficiency.

Table 2 demonstrated outcomes related to patient experience and procedural efficiency. Patient satisfaction scores were significantly higher in the digital group (8.9 ± 0.6) compared to the conventional group (7.1 ± 0.8), indicating improved comfort and acceptance of digital scanning procedures. Patients undergoing conventional impressions frequently reported discomfort due to tray size, material taste, and prolonged chair time, which likely contributed to lower satisfaction levels.

Clinical efficiency was also markedly improved in the digital group. The average impression procedure time was nearly half in digital impressions (6.2 ± 1.8 minutes) compared to conventional impressions (12.4 ± 3.1 minutes). Similarly, chairside adjustment time was significantly reduced in digital workflows (8.5 ± 2.7 minutes vs. 15.3 ± 4.2 minutes), reflecting better initial accuracy and reduced need for corrections.

Patient-related complications such as gag reflex were more frequent in the conventional group (35%) compared to the digital group (10%), further emphasizing the minimally invasive nature of intraoral scanning. Additionally, operator-reported ease of procedure was significantly higher in the digital group (87.5% vs. 32.5%), suggesting improved workflow ergonomics and reduced procedural complexity.

Overall, the results of this study demonstrated that digital impression techniques provided superior accuracy, enhanced patient satisfaction, and improved clinical efficiency compared to conventional impression methods. These findings supported the increasing integration of digital workflows in modern prosthodontic practice.

DISCUSSION:

The present study had evaluated the comparative performance of digital and conventional impression techniques in fixed prosthodontics, focusing on accuracy, patient satisfaction, and clinical efficiency. The findings had demonstrated that digital impression techniques had provided superior outcomes in several aspects compared with conventional methods. The advancement of intraoral scanning technology had significantly transformed prosthodontic workflows by reducing procedural limitations associated with traditional impression materials and improving the overall patient experience [9].

The accuracy assessment had revealed that digital impressions had achieved higher precision and better dimensional stability compared with conventional impressions. Conventional impression techniques had been affected by multiple variables, including material distortion, improper mixing ratios, tray selection, setting time, and dimensional changes during disinfection and transportation [10]. In contrast, digital scanners had captured three-dimensional oral structures directly, minimizing errors caused by material handling and allowing immediate visualization of scanned areas. The improved accuracy observed with

digital impressions had been particularly beneficial in fixed prosthodontic procedures where precise marginal adaptation, occlusal accuracy, and restoration fit were essential for long-term clinical success.

The study findings had also indicated improved patient satisfaction among individuals who underwent digital impression procedures [11]. Conventional impressions had frequently been associated with discomfort due to the presence of impression trays, unpleasant taste of materials, gag reflex stimulation, and prolonged intraoral setting time. Digital scanning had eliminated many of these discomfort factors by providing a faster and less invasive procedure. Patients had reported greater acceptance, improved comfort, and preference for digital methods due to reduced chair-side inconvenience. These findings had emphasized the importance of patient-centered approaches in modern dental practice, where clinical outcomes and patient experience were considered equally significant.

Clinical efficiency had been another major advantage observed with digital impression techniques. Digital workflows had reduced the overall impression-taking time and improved communication between dental professionals and laboratories [12]. The immediate transfer of digital files had eliminated delays associated with physical impression delivery and had facilitated faster fabrication of fixed prostheses. Additionally, digital impressions had allowed clinicians to identify scanning errors immediately and repeat only the required areas instead of repeating the entire procedure, which was commonly necessary with conventional impressions. This had contributed to improved workflow management and reduced clinical burden.

Despite these advantages, conventional impression techniques had continued to maintain clinical relevance due to their accessibility, lower equipment costs, and familiarity among dental professionals [13]. Some clinical situations with limited accessibility, extensive bleeding, moisture control difficulties, or subgingival preparation margins had presented challenges for digital scanning. The success of digital impressions had depended on operator experience, scanner technology, and proper clinical conditions. Therefore, adequate training and familiarity with digital systems had remained essential for achieving optimal results.

The findings had been consistent with previous research demonstrating that digital impressions had shown comparable or superior accuracy for fixed prosthodontic applications. Several studies had reported that modern intraoral scanners had achieved clinically acceptable accuracy for crowns, bridges, and implant-supported restorations. The improvement in scanning algorithms, image processing, and software integration had further enhanced the reliability of digital techniques. However, differences between scanner systems and variations in clinical protocols had influenced reported outcomes, indicating the need for standardized evaluation methods [14].

The economic and practical aspects of digital dentistry had also been considered. Although the initial investment in intraoral scanners and associated software had been substantial, long-term benefits had included reduced material costs, decreased laboratory communication errors, and improved productivity. With increasing adoption of computer-aided design and computer-aided manufacturing (CAD/CAM) technologies, digital impressions had become an important component of modern prosthodontic practice [15].

Overall, the study had demonstrated that digital impression techniques had provided significant advantages over conventional impressions in terms of accuracy, patient satisfaction, and clinical efficiency. While conventional methods had remained useful in specific situations, digital impressions had represented a more advanced, comfortable, and efficient approach for fixed prosthodontic procedures. The integration of digital technologies had therefore been considered a valuable step toward improving the quality, predictability, and patient experience of prosthodontic treatment.

CONCLUSION:

The present study had demonstrated that digital impression techniques had provided significant advantages over conventional impression methods in fixed prosthodontics. Digital approaches had shown improved clinical efficiency, greater patient comfort, reduced chairside time, and enhanced workflow management.

The accuracy of digital impressions had been comparable to, and in several cases superior to, conventional techniques, particularly in achieving precise restorations with better marginal adaptation. Patients had reported higher satisfaction levels with digital impressions due to reduced discomfort and a more convenient scanning experience. Although conventional impressions had remained reliable and cost-effective, they had been associated with limitations such as material-related errors, patient discomfort, and longer procedures. Overall, digital impression systems had represented a valuable advancement in prosthodontic practice and had improved the quality of fixed dental restorations. The findings had supported wider adoption of digital workflows while considering clinical requirements, accessibility, and practitioner expertise.

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