

Comparative Analysis of Conventional and Digital Impression Techniques in Prosthodontic Treatment

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Abstract

Accurate impression procedures play a decisive role in the success of prosthodontic treatment because the precision of fixed and removable restorations directly depends on the quality of reproduced oral structures. Conventional impression methods have been used for decades and remain widely applied in restorative dentistry; however, the rapid development of digital technologies has introduced new possibilities for improving diagnostic accuracy, patient comfort, and laboratory efficiency. The present study aimed to conduct a comparative analysis of conventional and digital impression techniques in prosthodontic treatment and to evaluate their clinical effectiveness, accuracy, treatment duration, and patient satisfaction. A total of 120 patients requiring prosthodontic rehabilitation participated in the investigation. Participants were divided into two equal groups according to the impression technique used. Conventional elastomeric impression materials were utilized in the first group, while intraoral digital scanning systems were applied in the second group. Clinical evaluation included assessment of marginal adaptation of prosthetic constructions, number of repeated impressions, patient comfort, working time, and clinician satisfaction. The findings demonstrated that digital impression techniques provided higher patient comfort, reduced chairside time, improved communication between clinician and laboratory technician, and minimized the frequency of repeated procedures. Conventional impressions, although still clinically effective, were associated with greater patient discomfort and increased risk of dimensional inaccuracies caused by material deformation and improper handling. The study confirms that digital impression systems represent a highly effective alternative to traditional methods in modern prosthodontic practice and contribute to optimization of clinical workflow and prosthetic precision.

Keywords: prosthodontics, digital dentistry, conventional impression, intraoral scanner, CAD/CAM, prosthetic rehabilitation, dental technology, impression accuracy, fixed prosthesis, restorative dentistry.

1. Introduction

Modern prosthodontic treatment requires precise reproduction of oral anatomical structures to ensure fabrication of functional and aesthetically acceptable dental restorations. Impression procedures therefore remain one of the most important stages in restorative and prosthetic dentistry. Accuracy of the obtained impression directly influences marginal integrity, occlusal adaptation,

retention, durability, and overall clinical success of prosthetic constructions.

For many years, conventional impression techniques based on elastomeric and hydrocolloid materials represented the standard approach in prosthodontic practice. These methods involve placement of impression trays filled with specific materials into the patient's oral cavity to reproduce hard and soft tissue morphology. Although traditional techniques provide clinically acceptable results in many cases, they are associated with several disadvantages, including patient discomfort, unpleasant taste, gag reflex stimulation, dimensional instability, material shrinkage, and risk of distortion during transportation and laboratory processing.

The introduction of digital technologies has significantly transformed restorative dentistry and prosthodontics during recent decades. Development of intraoral scanners and computer-aided design/computer-aided manufacturing systems has enabled clinicians to obtain highly accurate digital impressions without conventional impression materials. Digital scanning technology allows direct acquisition of three-dimensional images of intraoral structures and facilitates immediate transfer of data to dental laboratories for virtual modeling and prosthetic fabrication.

Digital impression techniques offer multiple clinical advantages, including reduction of treatment duration, elimination of material-related distortions, improved communication between dentist and technician, and increased patient acceptance. Intraoral scanning systems additionally permit real-time visualization of prepared teeth and enable immediate correction of scanning deficiencies during clinical procedures. Despite these advantages, certain limitations remain, including high financial cost of digital equipment, learning curve for clinicians, and technical difficulties encountered in extensive edentulous regions or subgingival preparation margins.

Although both impression approaches are currently utilized in prosthodontic practice, discussion continues regarding their relative clinical efficiency, precision, and practical applicability. Comparative analysis of conventional and digital methods therefore remains highly relevant for contemporary restorative dentistry.

The purpose of the present investigation was to evaluate and compare conventional and digital impression techniques in prosthodontic treatment according to clinical accuracy, patient comfort, treatment efficiency, and overall practical effectiveness.

2. Materials and Methods

The study was carried out at the Department of Prosthodontic Dentistry during 2024–2025. A total of 120 patients aged between 22 and 65 years requiring prosthodontic rehabilitation participated in the investigation. All participants underwent comprehensive clinical examination prior to treatment planning.

Patients were randomly divided into two equal groups consisting of 60 individuals each. Group I underwent conventional impression procedures using elastomeric silicone impression materials and standard impression trays. Group II received digital impressions using an intraoral scanning system integrated with CAD/CAM technology.

Inclusion criteria involved patients requiring single crowns, fixed partial dentures, or implant-supported restorations. Individuals with severe temporomandibular dysfunction, uncontrolled systemic diseases, extensive oral infections, or inability to cooperate during clinical procedures were excluded from the investigation.

For conventional impressions, gingival retraction was performed prior to impression taking when necessary. Polyvinyl siloxane impression materials were used according to manufacturer recommendations. Impressions were disinfected and transferred to the dental laboratory for gypsum model fabrication.

Digital impressions were obtained using a modern intraoral scanner under standardized clinical conditions. Scanning procedures included capture of prepared teeth, adjacent structures, and occlusal relationships. Digital files were immediately transferred to the laboratory for virtual model generation and prosthetic design.

The following parameters were evaluated:

- Accuracy of marginal adaptation of prosthetic restorations
- Number of repeated impression procedures
- Total clinical working time
- Patient comfort during impression taking
- Presence of gag reflex or discomfort

- Clinician satisfaction with impression quality
- Laboratory processing efficiency

Patient comfort was assessed using a visual analog scale ranging from 1 to 10. Marginal adaptation of restorations was clinically evaluated during prosthesis fitting appointments. Statistical analysis was performed using standard biomedical statistical methods, and significance was established at $p < 0.075$.

3. Results

Clinical evaluation demonstrated significant differences between conventional and digital impression techniques regarding patient comfort, treatment efficiency, and procedural accuracy. Patients who underwent digital intraoral scanning reported substantially lower levels of discomfort during impression procedures compared to individuals treated with traditional impression materials.

In Group I, many participants experienced unpleasant sensations related to impression tray placement, material taste, and prolonged setting time. Gag reflex and anxiety were particularly common among patients with increased oral sensitivity. Several conventional impressions required repetition because of air bubbles, marginal distortions, or incomplete reproduction of preparation margins.

In contrast, digital scanning procedures in Group II were completed more rapidly and were generally well tolerated by patients. Real-time visualization of scanned structures enabled immediate correction of missing areas without repeating the entire procedure. Most patients described the digital technique as more comfortable and less stressful compared to traditional methods.

Analysis of clinical working time revealed that digital impressions significantly reduced chairside duration. Conventional procedures required additional time for tray selection, material preparation, disinfection, and transportation to the dental laboratory. Digital systems simplified clinical workflow by enabling direct electronic transfer of data.

Marginal adaptation of prosthetic restorations fabricated from digital impressions demonstrated high clinical precision and satisfactory occlusal relationships. Digital models exhibited excellent detail reproduction, especially in fixed prosthodontic cases involving single crowns and short-span bridges. Conventional impressions also provided clinically acceptable restorations; however, minor inaccuracies associated with material deformation were occasionally identified.

Laboratory technicians reported improved communication and workflow efficiency when working with digital files. Virtual models facilitated prosthetic planning and reduced the need for remakes.

Furthermore, digital archiving of patient data simplified long-term record storage and retrieval.

Statistical analysis confirmed significantly greater patient satisfaction in the digital impression group.

Clinicians additionally noted enhanced convenience and reduced procedural stress during digital scanning procedures.

4. Discussion

The results of the present study confirm that digital impression technology represents an effective and clinically reliable alternative to conventional impression methods in prosthodontic treatment. Intraoral scanning systems demonstrated substantial advantages regarding patient comfort, workflow efficiency, and reduction of material-related inaccuracies.

Conventional impression techniques continue to provide acceptable clinical outcomes and remain widely utilized because of their accessibility and relatively low cost. Nevertheless, these procedures depend heavily on operator skill, material stability, environmental conditions, and laboratory handling. Dimensional changes occurring during polymerization and transportation may negatively influence precision of the final prosthetic restoration.

Digital impression systems eliminate many limitations associated with traditional materials and gypsum models. Direct acquisition of three-dimensional intraoral images minimizes risk of distortion and enables precise visualization of preparation margins and occlusal relationships. The ability to instantly evaluate scanning quality contributes to reduction of repeated procedures and improves treatment predictability.

Patient-centered advantages of digital techniques were particularly evident during the present investigation. Elimination of bulky impression trays and unpleasant impression materials significantly improved patient tolerance, especially among individuals with pronounced gag reflexes or dental

anxiety. Enhanced comfort may contribute positively to patient cooperation and overall satisfaction with prosthodontic treatment.

An additional benefit of digital dentistry involves optimization of communication between clinician and laboratory technician. Electronic transfer of digital files accelerates fabrication procedures and facilitates precise prosthetic planning using CAD/CAM systems. Digital workflows also support long-term storage of patient records without physical deterioration of models.

Despite numerous advantages, digital impression systems possess certain limitations. High initial financial investment and technical training requirements may restrict widespread implementation in some clinical settings. Furthermore, extensive edentulous arches and deep subgingival margins may still present scanning challenges requiring careful clinical management.

The findings of the study support the growing role of digital dentistry in contemporary prosthodontics and indicate that digital impression techniques may gradually replace conventional approaches in many restorative procedures. Further research involving larger patient populations and long-term prosthetic outcomes remains necessary for comprehensive evaluation of evolving digital technologies.

5. Conclusion

Comparative clinical evaluation demonstrated that digital impression techniques provide significant advantages over conventional impression methods in prosthodontic treatment. Intraoral scanning systems improved patient comfort, reduced clinical working time, minimized repeated procedures, and enhanced communication between dentist and laboratory technician.

Although traditional impression methods continue to demonstrate acceptable clinical effectiveness, digital technologies offer greater procedural efficiency and reduce inaccuracies associated with material deformation and manual handling. Digital impressions additionally contribute to improved workflow integration within CAD/CAM prosthodontic systems and facilitate precise fabrication of dental restorations.

The obtained findings confirm that digital impression techniques represent a reliable and перспективный direction in modern prosthodontic dentistry. Integration of digital technologies into routine clinical practice may significantly improve quality of prosthetic rehabilitation and optimize overall treatment outcomes.

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