ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 8, Issue – 1, January – 2025, Page No. : 01 - 05

Precision in Fixed Prosthodontics: A Comprehensive Review of Impression Techniques and Materials

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Citation of this Article: Dr. Shams Mohammadi, Tushar Khanna, Dr. Sukriti Dhanda, Dr. Baburajan Kandasamy, Dr. Pranav Sihora, Dr. M Sarmad Wasi,“Precision in Fixed Prosthodontics: A Comprehensive Review of Impression Techniques and Materials”, IJDSIR- January – 2025, Volume – 8, Issue – 1, P. No. 01 – 05.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

The accuracy of impressions is critical to the success of fixed prosthodontic restorations, influencing both functional and aesthetic outcomes. This article provides a detailed review of impression techniques and materials used in fixed prosthodontics, highlighting their respective strengths, limitations, and applications. Conventional methods, including one-step, two-step, and dual-viscosity techniques, are evaluated alongside modern digital approaches such as intraoral scanners and photogrammetry. The performance of elastomeric materials like polyvinyl siloxane and polyether is compared with that of non-elastomeric alternatives. Emphasis is placed on the impact of these techniques and materials on accuracy, patient comfort, and clinical workflow efficiency. The review underscores the transformative potential of digital impression systems and explores future advancements in materials and technology that promise to elevate the standard of care in fixed prosthodontics.

Keywords: Fixed Prosthodontics, Impression Techniques, Digital Impressions, Polyvinyl Siloxane (PVS), Prosthetic Accuracy, Dental Materials.

Introduction

The art and science of fixed prosthodontics demand a meticulous approach to ensure successful outcomes. Among the myriad factors influencing success, the accuracy of the impression process is paramount. An impression serves as the cornerstone for fabricating restorations, enabling dental laboratories to recreate the patient's oral anatomy with precision. The significance of this process cannot be overstated, as even minor discrepancies can lead to ill-fitting prostheses, resulting in compromised function, aesthetics, and longevity.[1,2]

Advancements in dental materials and technology have introduced a variety of techniques and tools aimed at enhancing the accuracy of impressions. While conventional impression methods have been the standard for decades, the advent of digital systems has ushered in a new era of precision and efficiency. However, the choice of technique and material must be carefully tailored to individual clinical scenarios, patient needs, and practitioner expertise. By understanding the nuances of each approach, clinicians can optimize outcomes and elevate the standard of care in fixed prosthodontics.[3,4]

Impression Techniques in Fixed Prosthodontics[5-7]

1. **Conventional Impression Techniques**

One-Step Technique

- A single mix of material is applied, capturing the dental structures in one go.
- Advantages: Time-efficient, minimal patient discomfort.
- Limitations: Susceptible to material distortion and inaccuracies.

Two-Step Technique

- A preliminary impression is taken, followed by a secondary impression using a different or additional material.
- Advantages: Improved detail reproduction and accuracy.
- Limitations: Increased chair time and potential material mismatch.

Dual-Viscosity Technique

- Combines a high-viscosity base material with a low-viscosity wash material.
- Advantages: Superior detail capture.
- Limitations: Technique-sensitive and may require experienced operators.

2. **Digital Impression Techniques[8-10]**

Intraoral Scanners

- Use of advanced optical or laser technologies to create a digital 3D model of the dental arches.
- Advantages: Enhanced precision, immediate visualization, reduced patient discomfort.
- Limitations: High initial investment and potential learning curve.

Photogrammetry

- Utilizes photographic data to reconstruct a detailed 3D image of the prepared tooth.
- Advantages: High accuracy for complex cases, particularly with implants.
- Limitations: Limited availability and potential for operator variability.

Impression Materials[11-13]

Elastomeric Materials

Polyvinyl Siloxane (PVS)

- Renowned for its dimensional stability, tear strength, and high accuracy.
- Applications: Crown and bridge impressions, implant restorations.
- Limitations: Hydrophobic nature may require a dry field.

Polyether

- Known for its superior hydrophilicity, making it suitable for moist environments.
- Applications: Full arch impressions and subgingival detail capture.

- Limitations: Stiffer consistency can make removal challenging.

Condensation Silicone

- Economical and easy to use but less dimensionally stable than PVS.
- Applications: Short-term applications.
- Limitations: Prone to shrinkage over time.

Non-Elastomeric Materials

Alginate

- Economical and user-friendly, primarily used for diagnostic casts.
- Limitations: Poor dimensional stability and low accuracy for final impressions.

Impression Plaster

- High rigidity, historically used for edentulous cases.
- Limitations: Fracture-prone and less common in modern practice.

Evaluation of Techniques and Materials[14-17]

Accuracy and Reproducibility:

- PVS and polyether consistently outperform other materials in dimensional accuracy.
- Digital impressions offer unparalleled reproducibility.

Patient Comfort

- Digital impressions significantly reduce patient discomfort compared to traditional techniques.
- The choice of impression material also influences patient experience, with softer materials like alginate being more comfortable but less precise.

Clinical Workflow Efficiency

- Digital systems streamline the workflow, eliminating the need for physical models and reducing turnaround times.

Future Directions[18-20]

Advancements in digital technology, including artificial intelligence and machine learning, promise further improvements in precision and efficiency. Research into novel impression materials with enhanced hydrophilicity and biocompatibility will also expand the possibilities in fixed prosthodontics.

Conclusion

The evolution of impression techniques and materials has greatly enhanced the precision and predictability of fixed prosthodontic restorations. While conventional methods remain viable, digital impressions are transforming clinical practice by offering unmatched accuracy and efficiency. Clinicians must judiciously select the appropriate technique and material based on clinical requirements, patient factors, and available technology.

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