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Case Study

Considerations in Conventional Impression Techniques in Contemporary Fixed Prosthodontics

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Abstract

Impressions are pivotal in ensuring accurate replication of the prepared tooth and surrounding tissues, which is essential for the successful fabrication of prosthetic restorations. Conventional techniques, such as one-step and two-step impressions using materials like addition silicone and polyether, remain widely used, despite advances in digital impressions. Through two clinical cases, the study evaluates the effects of material choice and technique on the quality of the fixed prosthesis. Results show that while there was no significant difference between the one-step and two-step methods, the two-step technique yielded greater precision at the preparation margin. Several key factors were identified for successful impression-taking, including proper material selection, adherence to manufacturer guidelines, effective tray use, and ensuring gingival retraction. The findings emphasize that the choice of technique and material must be tailored to the specific clinical scenario to achieve optimal prosthetic results.

Keywords: Conventional Impression; Fixed Proshodontics; Proshetic Restorations

Introduction

Dental prosthetics, a specialized branch of dental medicine, focuses on restoring and replacing dental tissues affected by coronal diseases and addressing tooth loss in the oral cavity. As a leading specialty within this field, it continually pioneers advancements that push the boundaries of innovation to enhance both functional and aesthetic outcomes, contributing to comprehensive oral rehabilitation [1]. Coronal diseases involve morphological changes in the tooth crown and its relationship with adjacent and/or opposing teeth. These changes affect the integrity, volume, shape, position, number, color, or structure of the dental crown, impacting one or more of its functions: phonation, mastication, occlusal function to varying degrees, and aesthetics [2].

To compensate for the loss of function caused by these conditions, prosthetic restorations can be conventionally crafted by a dental technician or digitally designed by a technician or prosthodontist, depending on the specific clinical requirements.. A critical step in fabricating prosthetic restorations is impression-taking, whose success depends on several factors such as technique, material

type, and patient condition [3]. Various impression methods are documented in the specialized literature, blending scientific principles with innovation and artistry. The choice of the most suitable technique depends on the clinical situation, material availability, and the clinician's knowledge and experience, allowing different solutions for the same problem due to the wide range of impression materials and techniques available [4,5].

For the fabrication of a prosthetic restoration, the dental technician requires accurate details of the oral cavity and dental arches. This information is obtained through an impression, in which a carefully selected material is introduced into the oral cavity in a malleable state, supported by a tray, and allowed to set into a stable form. The purpose of the impression is to create a dimensionally stable negative copy, which is then used to produce a model of the dental and oral structures through casting. This model serves as a positive replica that the technician need to fabricate the prosthetic restoration [6]. Impressions are utilized in fixed prosthetics for obtaining working and study casts, documentation casts and duplicate casts [7].

In fixed prosthodontics, the primary objective of impressions is to achieve precise and detailed replication of the prepared tooth and its surrounding structures [8]. This includes accurately capturing the shape, dimensions, and intricate details of the preparation, particularly the cervical margin, while ensuring an exact representation of its relationship with the marginal periodontium. Additionally, impressions must faithfully record the occlusal relief of opposing teeth and the spatial relationships with adjacent dentition [9]. These factors are essential for producing a highly accurate working model, which serves as the foundation for fabricating a well-fitting and functional fixed prosthesisIn fixed prosthetics, impression-taking is primarily of two types: conventional, using impression materials, and a more recent technique involving optical images processed by software (optical impression). Despite rapid technological advancements in optical impressions, conventional impressions have not yet been completely replaced, as deep subgingival areas remain difficult to access [10,11].

Achieving a precise fit of the prosthetic restoration requires an impression that accurately captures the intricate details and dimensions of the dental structures and their spatial relationships. Since the impression records both soft and hard tissues, a thorough understanding of periodontal anatomy and the careful selection of an appropriate impression technique are crucial for a successful clinical outcome [12,13].

The selection of impression methods and materials in conventional techniques is guided by several key criteria [14,15]. These include the accuracy of the impression material as well as the mixing and dispensing systems employed, the available working time for the practitioner to take the impression, and the dimensional stability of the material. Additionally, the specific characteristics of the prosthetic field, in relation to the fixed prosthesis to be fabricated, must be considered. It is also important to account for the ability to preserve and consistently reproduce the cast, as well as the availability and suitability of the methods and materials for cast fabrication.

The essential requirements for an impression material in fixed prosthodontics include elasticity, good mechanical strength, plasticity, accuracy, dimensional stability, appropriate setting time, and compatibility with the materials used for model fabrication [16-18]. In addition to these, there are several secondary conditions that are desirable for impression materials to meet. The secondary conditions refer to a pleasant smell and taste, the absence of irritating or toxic components, a long shelf life, ease of use without requiring complex equipment, easy removal from the prosthetic field, and low cost [19,20].

This article aims to evaluate the clinical outcomes of different impression materials and techniques through the presentation of two distinct cases. The objectives are to assess the impact of material selection on the quality of the fixed prostheses and to identify key factors that contribute to the successful execution of prosthetic treatments.

Clinical Case 1

A 27-year-old woman, presented to the dental office complaining of food retention at teeth 1.4 and 1.5, along with sensitivity to sweet foods. During the medical history interview, the patient reported that the proximal fillings on these teeth had been replaced three times in the past five years. The clinical examination revealed an occluso-distal filling on the first premolar and a mesio-occluso-distal filling on the second premolar. The proximal fillings were found to be improperly adapted at the margins, and the contact point was deficient (Figure 1, 2, 3).

Figure 1: Frontal view in maximum intercuspation.

Figure 2: Lateral aspect in maximum intercuspation.

Figure 3: Occlusal view

Food retention indicates a deficient contact point, and restoring it with a direct filling (using matrices) is significantly more demanding and time-consuming compared to having the contact point created in a laboratory setting. Therefore, as a prosthetic treatment option for this case, an inlay was selected for tooth 1.4 and an onlay for tooth 1.5, both fabricated from IPS e.max Press (Ivoclar Vivadent). The patient agreed to the proposed treatment plan and provided written informed consent for the publication of all case details and associated photographs.

The inlay/onlay preparations were performed after the removal of altered dentin and old filling materials, following general design principles: ensuring the insertion axis, rounding all angles, defining well-structured preparation margins – a shoulder – for proper marginal sealing, positioning the preparation margins in healthy tooth structure, and placing the margins at least 0.5 – 1 mm away from the occlusal stop. Additionally, retraction cords were placed to facilitate proper finishing of the cervical margins (Figure 4, 5).

Figure 4: View of the preparations in maximum intercuspation.

Figure 5: View of the preparations from occlusal.

After completing the tooth preparations, the next step was impression-taking. The impression was made using a hemi-arch tray (Kettenbach), into which polyether material was added. The impression captured the prepared teeth, opposing dentition, and interocclusal relationship simultaneously. The technique employed was the single-step, two-phase method, utilizing two viscosities of polyether: light body and medium body (Impregum, 3M) (Figure 6, 7).

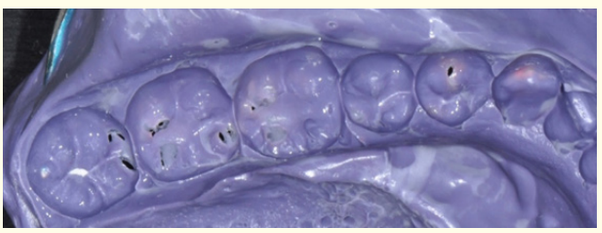

Figure 6: Impression of the opposite dentition.

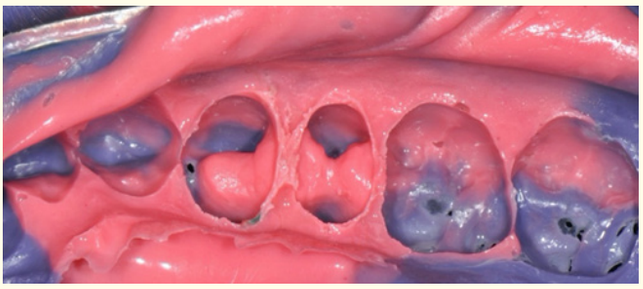

Figure 7: Impression of the prepared teeth.

For the temporary restoration of such a cavity, it is recommended to use a material that can be easily removed without the need for rotary instruments. The use of rotary instruments could alter the preparation design, compromising the adaptation of the final restorations. In this patient's case, Telio CS Onlay/Inlay, a light-curing composite material designed for temporary restorations, was utilized (Figure 8, 9).

Figure 8: Temporary restorations in maximum intercuspation.

Figure 9: Temporary restorations – oclusal view.

In the dental laboratory, the inlay and onlay were fabricated from IPS e.max Press (Ivoclar Vivadent) as monolithic restorations (Figure 11, 12). Subsequently, the restorations were polished and prepared for placement.

Figure 10: The inlay and onlay placed on the working cast.

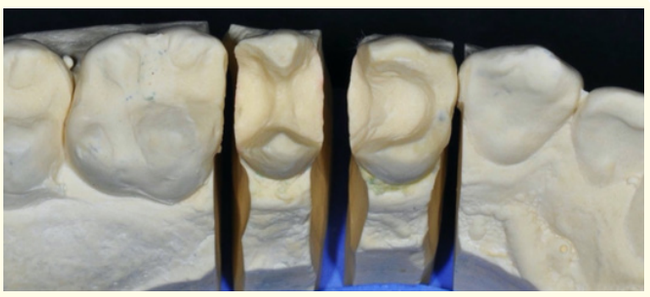

Figure 11: The working gypsum cast.

Figure 12: Final aspect of the prosthetic restorations in maximum intercuspation, after cementation.

The final clinical step was adhesive cementation using a dual-cure composite cement (Variolink Esthetic DC) (Figure 13, 14).

Figure 13: Final aspect of the prosthetic restorations- occlusal view.

Figure 14: Initial aspect of the dentition in the frontal view.

Clinical Case 2

A 32-year-old woman sought dental care with concerns about the aesthetic appearance of her teeth 2.3 and 2.4. The clinical examination revealed noticeable color alterations in both teeth, which were attributed to devitalization (Figure 15-18). After a comprehensive assessment, a complex treatment plan was devised in collaboration with the patient to address both the functional and aesthetic concerns of these teeth. The plan included the retreatment of the endodontic procedures to ensure the stability of the tooth stumps and to prevent periapical complications. This was followed by the fabrication of two full-ceramic crowns using IPS e.max Press, selected for their superior aesthetic qualities and durability. The aim of this multifaceted approach was not only to restore the color and appearance of the teeth but also to enhance their overall functionality, ensuring a long-term, stable solution for the patient's dental needs.

Figure 15: Initial aspect of the dentition in the lateral view.

Figure 16: Initial aspect of the dentition in the antero-lateral view.

Figure 17: Aspect of teeth 2.3 and 2.4 after endodontic retreatment – occlusal view.

Figure 18: The clinical aspect of the abutments.

Full-ceramic crowns were chosen for aesthetic demands, as they maintain color stability over time. However, they require a significant sacrifice of dental tissue. Another reason for selecting this treatment was the structural weakness of devitalized teeth, which become more brittle over time. Ceramic crowns provide long-term stability and enhanced resistance due to the ferrule effect. The patient signed the imformed consent for the treatment plan, agreeing also the use of all the case details and photos to be published.

Color selection was performed at the start of the tooth preparation procedure, ensuring that the teeth were fully hydrated. The preparation of both teeth adhered to biological, mechanical, and aesthetic principles. Anatomical tooth reduction was carried out

to remove a significant amount of hard tissue for aesthetic purposes, ensuring adequate space for the crown to effectively mask the stump color. When altering the color or shape of a tooth, subgingival preparation is essential while adhering to the biological, mechanical, and aesthetic guidelines. Different marginal shoulder widths were created to accommodate the varying initial coloration of the teeth and the final tooth stumps.

The finishing of the preparations was achieved using gingival retraction cords, allowing for direct visual control over the margins (Figure 19, 20).

Figure 19: The clinical aspect of the abutments in maximum intercupstaion.

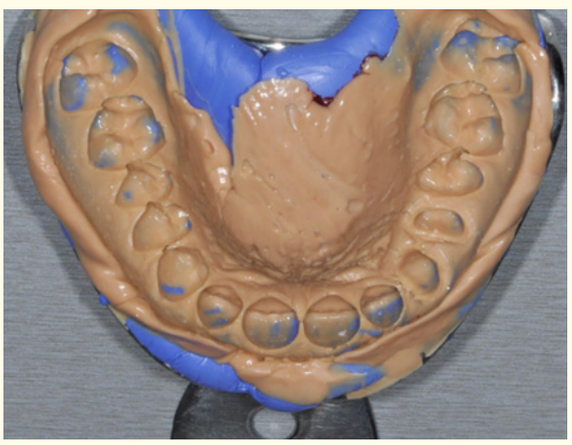

Figure 20: Impression of the maxillary arch.

For full-ceramic restorations (IPS e.max Press), it is essential to determine and record the color of the prepared teeth [21,22]. In the dental laboratory, esthetic composite abutments were fabricated to verify the final shade of the restorations. The two-step, two-phase impression technique was used with Virtual Putty and Light Body (addition silicone). The opposing dentition was recorded using alginate impressions. The maximum intercuspation relationship was captured with Virtual CAD Bite Registration (addition silicone) (Figure 21-24).

Figure 21: Impression of the opposite dentition.

Figure 22: The occlusal recording.

Figure 23: Working cast with e.max crowns.

Figure 24: Post-cementation aspect in maximum intercuspation.

The adhesive cementation was performed using Variolink Esthetic LC (Ivoclar Vivadent) (Figure 25-26).

Figure 25: Post-cementation aspect – anterior-lateral view.

Discussions

The importance of impression-taking in achieving a properly adapted fixed prosthetic restoration has been well-documented in the literature. The selection of the optimal impression technique is heavily dependent on both the type of restoration being fabricated and the individual patient's clinical situation [23]. A precise impression is essential for the successful creation of a restoration that is functional, durable, and aesthetically pleasing. The choice of impression material and technique can significantly influence the final outcome, affecting the prosthesis' fit, longevity, and overall patient comfort.

The results of our study did not show a significant difference in accuracy between the one-step and two-step impression techniques. However, the two-step method demonstrated greater precision, particularly at the preparation margin. This suggests that while both techniques can be clinically acceptable, the two-step method may provide more detailed replication of the prepared tooth and surrounding structures. This increased precision is particularly important when working with complex preparations, where even slight discrepancies in fit could result in marginal errors or aesthetic challenges.

The scientific literature highligh that addition silicone is still the most commonly used material for fixed prosthetic restorations [24]. This finding aligns with current clinical practice, where addition silicones are favored for their dimensional stability, high accuracy, and ease of use. These properties make addition silicones the material of choice for many clinicians, supporting the continued preference for conventional impression-taking methods, despite the growing prevalence of digital technologies. Research in the field has consistently indicated that polyether materials, while offering superior precision, are less commonly used in comparison to addition silicones [25]. This preference can be attributed to the latter's excellent handling characteristics, such as low viscosity, tear strength, and overall user-friendliness.

Further, our study emphasized that conventional impression techniques, particularly those using materials like addition silicone, remain a reliable and predictable option in many clinical scenarios. However, digital impressions are increasingly favored for their convenience and the potential to improve efficiency in the workflow [26,27]. The findings also underscore the importance of selecting the appropriate impression material based on the specific clinical circumstances. Factors such as the patient's condition, the complexity of the preparation, and the type of restoration required must be considered when choosing between different impression materials and techniques [28].

First, the choice of impression material and method must be tailored to the clinical situation. The type of restoration, the complexity of the preparation, and the specific needs of the patient all influence this decision. It is essential to choose highly hydrophilic materials, such as polyethers or addition silicones, which provide greater accuracy in moist environments and ensure that the material flows properly around the margins and other intricate areas of the preparation. Additionally, the preparation and use of the impression material must strictly follow the manufacturer's instructions, including proper mixing and recommended setting times, to achieve the desired results [29].

The selection of the impression tray is equally important. The tray must be rigid and durable, with an appropriate shape to accommodate the dental arch being captured. To enhance the adhesion of the impression material and minimize the risk of setting shrinkage, it is advisable to apply an adhesive to the tray. This practice ensures a more stable and accurate impression, particularly when using materials prone to dimensional changes during setting [30,31].

The correct handling of the impression material is another vital aspect of the impression procedure. For instance, when injecting fluid impression material into the tray, it is crucial to ensure that the syringe tip remains immersed in the material to avoid air bubbles, which can compromise the accuracy of the impression. Furthermore, the impression tray should be carefully inserted into the oral cavity with controlled pressure to prevent any unintended contact between the tray and the teeth or gingiva. Once positioned, the tray should remain undisturbed to maintain the integrity of the impression, avoiding movements that could alter its alignment [32].

Equally critical is the role of gingival retraction in achieving a precise impression. Proper gingival retraction is necessary to expose the preparation margins fully, allowing for accurate capture. This can be achieved using both mechanical methods, such as retraction cords, and chemical methods, such as astringent substances that assist in tissue displacement. Adequate drying of the prosthetic

field is essential before taking the impression to ensure the best possible adhesion of the material to the tooth structure [33,34].

When removing the impression, it is recommended to avoid any unilateral rotation of the tray, as this could lead to distortion of the impression and jeopardize the accuracy of the final model. After removal, the impression should be carefully examined, particularly at the preparation margins, to ensure that all areas have been accurately captured. The preparation margins are often the most challenging to replicate, and any discrepancies could result in poor adaptation of the final restoration [35].

Finally, once the impression has been verified for accuracy, it should be rinsed under running water, disinfected, and stored following the manufacturer's instructions to maintain its dimensional stability before being sent to the dental laboratory for model casting. Proper handling and storage of the impression material are necessary to prevent distortion, contamination, or any other factors that could compromise the quality of the final prosthesis [36,37].

Conclusions

The success of impression-taking is contingent upon careful attention to the materials, technique, and clinical environment. By adhering to established protocols and ensuring optimal conditions during the impression process, clinicians can significantly improve the accuracy of the final restoration, ensuring both functional and aesthetic satisfaction for the patient. The careful selection and meticulous execution of each step in the impression process form the foundation for achieving predictable, high-quality fixed prosthodontic restorations.The impression-taking process represents the most critical clinical phase in the fabrication of both fixed and removable prosthetic restorations.

The objectives of impression-taking are diverse but can be summarized as achieving the highest possible accuracy in reproducing all the details of the prosthetic field. This can only be accomplished through a thorough examination of the prosthetic field, correlated with the physical and chemical properties of the impression materials.

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