



COMPARISON BETWEEN CONVENTIONAL AND DIGITAL DIAGNOSTIC WAX-UPS IN THE AESTHETIC AND FUNCTIONAL PREDICTABILITY OF DENTAL PROSTHESES

Comparação entre enceramentos diagnósticos convencionais e digitais na previsibilidade estética e funcional de próteses dentárias

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ABSTRACT

This study addresses the comparison between conventional methods of diagnostic wax-up and digital techniques applied to dentistry, focusing on the aesthetic and functional predictability of dental prostheses. Traditional diagnostic wax-up, performed manually with wax, allows professionals to plan and visualize the final result of the treatment, while digital wax-up, through specialized software, offers greater precision and flexibility in the process. The research explores the advantages and limitations of both methods, highlighting the effectiveness of digital wax-up in creating three-dimensional representations, which facilitates adjustments and modifications in planning. In addition, the study discusses how these methods contribute to the aesthetic and functional adaptation of prostheses, considering the complexity of clinical cases and the experience of professionals. Keywords: Diagnostic Wax-up, Digital Modeling, Dental Aesthetics, Prosthesis Functionality Dental Planning and CAD/CAM technology. The use of techniques such as mock-up and the preview of the final result are discussed as effective tools to increase patient satisfaction and improve clinical outcomes. Although digital waxing has advantages in terms of accuracy and agility, traditional waxing is still widely used due to its affordable cost and familiarity among professionals. This study concludes that, with the advancement of technologies and the reduction of costs, digital wax-cutting tends to become the predominant choice, but the choice between the methods must consider the clinical situation and the patient's needs.

Keywords: Diagnostic wax-up, digital modeling, dental aesthetics, prosthesis functionality, dental planning, CAD/CAM technology.

RESUMO

Este estudo aborda a comparação entre métodos convencionais de enceramento diagnóstico e técnicas digitais aplicadas à odontologia, com foco na previsibilidade estética e funcional de próteses dentárias. O enceramento diagnóstico tradicional, realizado manualmente com cera, permite aos profissionais planejar e visualizar o resultado final do tratamento, enquanto o enceramento digital, por meio de software especializado, oferece maior precisão e flexibilidade no processo. A pesquisa explora as vantagens e limitações de ambos os métodos, destacando a eficácia do enceramento digital na criação de representações tridimensionais, o que facilita ajustes e modificações no planejamento. Além disso, o estudo discute como esses métodos contribuem para a adaptação estética e funcional de próteses, considerando a complexidade dos casos clínicos e a experiência dos profissionais. Palavras-chave: Enceramento diagnóstico, Modelagem digital, Estética dentária, Funcionalidade da prótese, Planejamento odontológico e tecnologia CAD/CAM. O uso de técnicas como o mock-up e a visualização prévia do resultado final são discutidos como ferramentas eficazes para aumentar a satisfação do paciente e melhorar os resultados clínicos. Embora a depilação digital tenha vantagens em termos de precisão e agilidade, a depilação tradicional ainda é amplamente utilizada devido ao seu custo acessível e familiaridade entre os profissionais. Este estudo conclui que, com o avanço das tecnologias e a redução de custos, a depilação digital tende a se tornar a escolha predominante, mas a escolha entre os métodos deve considerar a situação clínica e as necessidades do paciente.

Palavras-chave: Enceramento diagnóstico, modelagem digital, estética dentária, funcionalidade da prótese, planejamento odontológico, tecnologia CAD/CAM.

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INTRODUCTION

The comparison between conventional and digital diagnostic wax-ups has been gaining prominence in dentistry, particularly due to the pursuit of more predictable aesthetic and functional outcomes. Traditional diagnostic wax-ups, manually performed with wax, allow the dentist to visualize and plan treatment, but they are subject to human errors and limitations in fine-tuning the prosthesis. In contrast, the use of digital technologies, such as intraoral scanning and CAD/CAM software, provides greater precision and flexibility in planning, enhancing the aesthetic and functional predictability of prostheses^[1].

Digital wax-ups stand out for their ability to generate highly accurate three-dimensional models, facilitating the customization of prostheses and improving communication between the dentist and the laboratory. Studies have shown that the adoption of these technologies can result in a more precise fit and a more natural aesthetic, in addition to optimizing production time and reducing the occurrence of errors^[2]. However, the learning curve associated with the use of these tools, as well as the initial implementation costs, can represent a challenge, especially for smaller practices^[3].

Despite the advantages in terms of precision and speed, traditional wax-ups are still widely used, particularly in situations where cost is a determining factor or in clinical cases that do not require high aesthetic sophistication. The

familiarity of professionals with conventional techniques also contributes to their continued use in clinical practice. However, with technological advancements and cost reductions, it is expected that digital wax-ups will become increasingly accessible and prevalent in dentistry^[4].

The introduction of digital wax-ups represents a true revolution in prosthetic planning, offering a more efficient and personalized approach. Furthermore, the ability to visualize and modify the digital plan before the fabrication of the definitive prosthesis improves the patient experience and increases treatment predictability. Nevertheless, the transition to this technology should be carried out carefully, taking into account the patient's needs and the clinical conditions of each case^[5].

The use of digital wax-ups also enhances the integration between the clinic and the prosthetic laboratory, making the process more agile and efficient. Real-time communication among professionals allows for immediate adjustments to the prosthesis planning, reducing the occurrence of errors in information transfer. Furthermore, the digitization of the process facilitates traceability and control over the patient's history, making care more transparent and secure^[5].

However, the transition to digital technologies requires constant updating by professionals. With the advancement of digital tools, dentists need specialized training to fully exploit the potential of digital wax-ups. For successful implementation, it is essential that clinics

adapt both in terms of infrastructure and team training, ensuring care that meets the new demands of patients and technological advancements^[5].

METHODOLOGY

This study was conducted through a literature review with the objective of comparing conventional and digital diagnostic wax-up methods, analyzing their aesthetic and functional predictability in prosthetic rehabilitation. The research was based on scientific articles and academic publications indexed in databases such as PubMed, Scopus, and Google Scholar, with priority given to studies published in the last ten years. The selection of articles was based on keywords such as “diagnostic wax-up,” “digital prostheses,” “wax-up precision,” and “CAD/CAM technology,” ensuring a comprehensive and relevant approach for the proposed analysis^[6].

Type of study

This study is qualitative, exploratory, and descriptive in nature, based on the analysis of scientific literature regarding the application of diagnostic wax-up techniques. The qualitative approach allows for an in-depth understanding of the advantages and limitations of each method, while the exploratory approach enables the identification of trends and challenges in the adoption of digital technologies in prosthetic planning^[7].

Inclusion and exclusion criteria

Articles were selected based on the following criteria:

- Comparison between conventional and digital diagnostic wax-ups in dentistry.
- Evaluation of the aesthetic and functional predictability of prostheses produced by both techniques.
- Studies on the effectiveness of CAD/CAM technologies in prosthetic planning and adaptation. Articles that did not directly address the proposed topic, studies without scientific basis, and materials that did not present a comparison between the two waxing methods were excluded^[8].

Data collection and analysis

Data collection was conducted through critical reading and analysis of the selected articles. The extracted information was organized into three main axes:

1. Comparison between conventional and digital diagnostic waxing techniques,
2. Evaluation of the aesthetic predictability of prostheses,
3. Functional analysis and adaptability of prostheses produced by both techniques.

The data were analyzed in light of scientific references, providing a detailed view of the advantages and disadvantages of each technique in prosthetic planning and prosthesis adaptation^[9].

Study Limitations

As this study is a literature review, it does not involve the collection of primary data, which may represent a limitation in applying the results to specific contexts. Furthermore, the literature on the use of digital techniques in diagnostic wax-ups is still evolving, highlighting the need for more empirical studies to validate and further develop the presented conclusions^[10].

RESULTS AND DISCUSSION

The comparison between conventional and digital diagnostic wax-up methods has garnered increasing interest in dentistry, particularly regarding the aesthetic and functional predictability of prostheses. The incorporation of digital technologies, such as intraoral scanning and CAD/CAM software, has brought significant advancements over traditional methods, providing greater accuracy in prosthetic adaptation. Recent studies indicate that the use of these technologies enables the creation of highly detailed three-dimensional models, facilitating quick adjustments and improving visualization of the results before the final fabrication of prostheses^[11]. These innovations are especially advantageous in cases requiring a high level of aesthetic customization, such as anterior rehabilitations and advanced aesthetic prostheses.

Comparison Between Conventional and Digital Wax-Ups

Conventional diagnostic wax-ups, manually created with wax, have been the standard approach in dentistry for decades,

allowing dentists to plan treatment in a visual and tangible manner. However, their accuracy may be limited by the clinician's skill and the physical properties of the material, such as potential distortions resulting from the wax's drying time. With the introduction of digital wax-ups, this process has undergone a transformation, enabling the creation of highly precise three-dimensional models that can be manipulated and adjusted with greater flexibility. The use of intraoral scanning, combined with CAD software, allows for visualization of the final prosthetic outcome even before its fabrication, ensuring greater predictability in treatment and more satisfactory results for patients^[12]. This not only enhances aesthetics but also improves the functional adaptation of prostheses, contributing to a more effective and predictable treatment.

Aesthetic and Functional Impact of Digital Models

The aesthetics of prostheses is a central concern in modern dentistry, especially in treatments involving anterior teeth and visible restorations. Digital wax-ups provide more precise control over aesthetic details, allowing clinicians to visualize and adjust every aspect of the prosthesis—such as shape, alignment, and proportions—in a more realistic manner. Additionally, digital modeling software enables instant modifications, ensuring greater flexibility and customization in treatment planning. In contrast to manual wax-ups, where adjustments

can be more time-consuming and prone to human error, the digital process offers a more efficient and predictable approach. Beyond enhanced aesthetics, the functionality of prostheses also benefits from the precision of digital models, which ensure a better adaptation to the patient's anatomy, resulting in improved occlusion, comfort, and longevity of the rehabilitation^[13].

Efficiency and Reduction of Production Time

The introduction of digital technologies has brought significant benefits in terms of efficiency and reduced prosthesis production time. Intraoral scanning and digital modeling eliminate several steps of the conventional process, such as wax manipulation and the transfer of physical models to the laboratory. Additionally, the agility of the digital workflow allows for quick and precise adjustments without the need for new impressions, making patient care more dynamic. This optimization not only reduces clinical time but also enhances the productivity of dental clinics. A study by Guedes et al. (2021) indicates that the implementation of digital wax-ups can reduce total prosthesis production time by up to 30%, while also minimizing the need for adjustments after final fabrication^[14].

Functional Adaptation of Prostheses

The functional adaptation of prostheses is a key factor in the success of treatment, ensuring comfort, stability, and durability. The

precision offered by digital models allows for the fabrication of prostheses with a more refined fit to the patient's anatomy, optimizing occlusion and providing greater comfort during use. This aspect is particularly relevant in complete and partial prostheses, where functional adequacy is essential for the longevity and performance of the treatment. The use of digital tools enables highly precise adjustments, often impossible to achieve with manual modeling, significantly reducing the need for modifications after prosthesis installation. Additionally, integration with technologies such as 3D printing allows for the production of lighter prostheses with a more precise fit, enhancing both the patient experience and clinical efficiency^[15].

CONCLUSION

The comparison between conventional and digital diagnostic waxing methods in dentistry highlights that, although both play a fundamental role in prosthetic adaptation, digital technologies offer significant advantages, particularly in terms of precision, flexibility, and production speed. Studies show that digital waxing, utilizing intraoral scanning and CAD/CAM software, enhances the aesthetic and functional predictability of prostheses, allowing for faster and more precise adjustments. In addition to optimizing aesthetics, this technology contributes to superior functional adaptation, resulting in more effective and satisfactory treatments for patients^[16].

Despite the increasing adoption of digital models, conventional gypsum models are still widely used, especially in clinics that lack the infrastructure for more advanced technologies. The familiarity of professionals with manual techniques and the affordability of traditional materials also support the continued use of these models in certain contexts. However, as digital solutions become more accessible and specialized training expands, digital waxing is expected to become the standard, particularly for cases requiring high precision and customization^[17].

The transition from conventional to digital waxing requires adaptation from both professionals and patients. Training dentists in these new technologies is essential for fully leveraging their benefits. Additionally, the ability to preview results provides patients with a more positive experience, increasing treatment predictability and confidence. Communication between dentists and laboratories also becomes more efficient, reducing production time and operational costs^[18].

Thus, the choice between conventional and digital diagnostic waxing should consider factors such as the complexity of the clinical case, the professional's experience, and the associated costs. Both methods have their value, but the advancement of digital technologies points to a future where precision, customization, and efficiency in prosthetic planning will continue to improve. The ongoing evolution of these tools and the adaptation of dental professionals will be crucial in establishing digital models as the predominant approach in prosthetic treatments^[19].

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Observação: os/(as) autores/(as) declaram não existir conflitos de interesses de qualquer natureza.