Minimally Invasive Digital Denture Duplication with Extra – Oral Scanning and 3D Milling for Enhanced Patient Comfort in Dementia Care: A Technical Cased Report

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Abstract: Aim & Background: Traditional complete denture protocols typically involve several patient appointments and multiple laboratory procedures. However, various workflows integrating digital technology can streamline the process, enhancing speed and predictability. This technical case report represents a digital denture duplication process.
Case Description: The 67-year-old male patient diagnosed with mild dementia presented with well-formed edentulous ridges and a history of maxillary and mandibular complete dentures. Due to his medical condition, he required a backup set. A reliable and efficient method involving extra-oral scanning, printing trial dentures, a functional impression, and scanning of trial dentures followed by 3D milling was used to replicate the existing dentures with minimal discomfort. The patient expressed satisfaction regarding retention, stability, and aesthetics.
Conclusion: This case demonstrates the effectiveness of digital technology in meeting the needs of elderly and cognitively impaired patients, providing a practical solution for maintaining denture function and aesthetics.
Clinical significance—Digital technology provides the advantage of faster turnaround times for denture duplication, which is particularly beneficial in managing the needs of dementia patients who may require quick adjustments or replacements due to their condition.

Keywords: Milling, Extra-oral scanner, Complete denture, Exocad, Replica denture

1. Introduction

The growing prevalence of dementia presents unique challenges in dental care, particularly for patients who rely on removable prosthetics, such as dentures, for functional and aesthetic restoration.[1] Dementia can impair cognitive and motor skills, making it difficult for patients to communicate or maintain their dentures, often leading to complications like discomfort, ill-fitting prosthetics, or difficulty with denture replacement.[2] As the demand for effective dental solutions for dementia patients rises, there is an increasing need for innovative approaches to address these challenges.
Digital denture duplication offers a promising solution to these concerns. This technique involves using digital scanning, advanced software, and 3D printing or milling technologies to create precise replicas of existing dentures.[3] For dementia patients, replicating dentures accurately is particularly beneficial, as it can minimise the need for multiple appointments or adjustments, which may be stressful or difficult for these individuals. Moreover, digital denture duplication ensures that the denture's original functional

and aesthetic qualities, & also offering comfort and stability without the need for extensive chair-side visits.[4]This technical case report explores a reliable approach to digital denture duplication tailored for dementia patients.

2. Case Description

A 67-year-old male patient with a two-year history of mild dementia reported to the Prosthodontic department requesting a backup denture. The patient had maxillary and mandibular complete dentures that he was generally satisfied with regarding both function and aesthetics, but he occasionally experienced issues with denture retention. On medical examination, the patient was diagnosed with mild dementia and had well-formed edentulous ridges with adequate denture extension on oral examination. There was no significant tissue irritation or other clinical concerns, but the patient sought a backup denture due to his medical condition, which could impact his ability to care for or maintain his current dentures.

The patient's existing dentures were evaluated for retention, stability, and occlusion. Subjective feedback was also obtained from the patient, who expressed occasional dissatisfaction with denture retention but was otherwise pleased with the overall fit and appearance.

Denture Duplication Process

A digital denture duplication technique was chosen to address the patient's needs. The following steps were involved in the procedure:

Digital Scanning: An extra-oral scanner (Medit T710 3D Scanner) was used to capture the intricate details of the existing dentures, ensuring high fidelity in the digital model (Figure 1). This technology provided precise imaging of the dentures' internal and external surfaces.

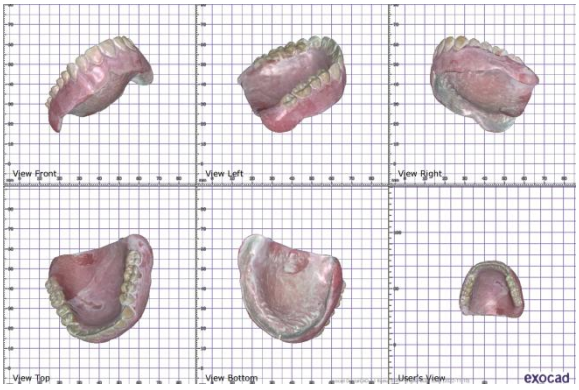

Figure 1 The scanned image of the existing complete denture in exocad software in different side views

Trial Denture Fabrication: The captured Standard Tessellation Language(STL) files were designed for a trial denture, printed from a PMMA resin block (Digitalife-zenith) using a 3D printer (Ackuretta SOL-130) (Figure 2). This trial denture was a test model to assess extension, vertical dimension, occlusion, and phonetics.

Figure 2 Printed Trial Denture

Functional Impressions: Once the patient approved the trial denture, functional impressions were made using light-body addition silicone material for both the maxillary and mandibular arches. The closed-mouth impression technique accurately represented the patient's denture fit (Figure 3).

Figure 3 Functional impression taken using trial denture

Final Denture Design and Printing: The trial denture was scanned again using the extra-oral scanner (Medit T710 3D Scanner), and the STL files were analysed in Exocad software. The artificial teeth and pink denture base were designed and separately printed using a milling machine (imes icore-350i loder PRO). The artificial teeth were carefully selected to match the patient's preferences, and the pink base was designed for optimal aesthetic and functional integration (Figure 4).

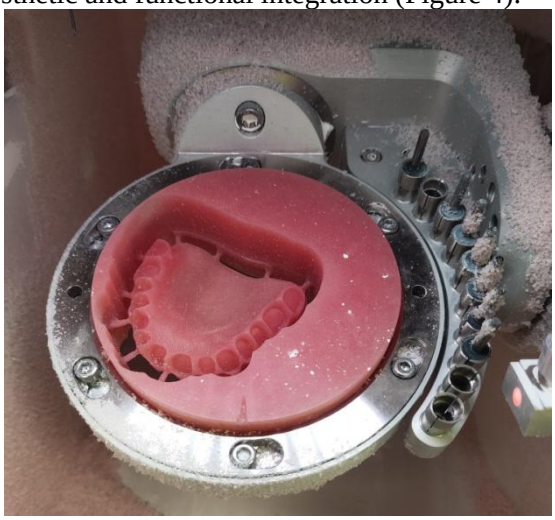

Figure 4 Fabrication of denture using a 3D milling machine

Denture Assembly: The two parts—the artificial teeth and the pink denture base—were fused using self-cure acrylic resin (DPI), completing the digital duplication process.

Final Insertion and Evaluation: The finished duplicated denture was inserted into the patient's mouth and evaluated for retention, stability, occlusion, and aesthetics (Figure 5). The denture fit was satisfactory, and the patient reported comfort with no issues regarding retention or function.

Figure 5 Pre & Post insertion of duplicate complete denture

3. Discussion

This technical case highlights the potential of digital denture duplication as a reliable and efficient method for replicating dentures, especially for patients with cognitive impairments like dementia. The early symptoms of dementia include difficulty concentrating, daily task challenges, and disorientation. It causes severe memory loss, communication difficulties, reduced mobility, and behavioural changes in later stages.[5]Traditional denture duplication methods often require multiple appointments and adjustments, which may be challenging for dementia patients. In contrast, digital techniques minimise the need for extensive chair-side visits, ensuring a more comfortable and stress-free experience for the patient.[6] Moreover, the high precision afforded by digital scanning and 3D milling technologies ensures that the final product closely mirrors the original dentures, maintaining both functional and aesthetic quality.[7]

This technical case report uses extra-oral scanners designed to scan impressions or models efficiently. Scanning a physical model or impression outside the mouth often reduces errors caused by saliva, tongue movement, or patient discomfort, and also, in previous studies, extra-oral scanners show better trueness & precision than intra-oral scanners.[8,9]This scan produced the STL files, which could be sent directly to a milling machine. The trial denture was printed from a polymethyl methacrylate (PMMA) monolithic resin block. The trial denture eliminates the need for the traditional wax try-in, enabling the clinician and patient to assess key clinical determinants such as vertical dimension, occlusion, appearance, & phonetics.[10]Furthermore, it allows for the assessment of retention & extension of the flange, as the printed trial base closely mirrors the final denture base.[10]Due to the prolonged usage of the denture for three years by the patient, there would be changes in the bone architecture and bone remodelling have occurred, so a functional impression of the trial denture was made to improve the retention of the final prosthesis.[11]

Arslan et al compared milled Polymethyl methacrylate (PMMA) with conventionally fabricated denture base materials and discovered that the milled material exhibited superior flexural strength.[12]And also digital complete dentures exhibited greater masticatory force and improved grinding efficiency compared to conventional complete dentures.[13]The denture base and artificial teeth were milled separately and fused by self-cure acrylic resin.[14] Separating the materials ensures precise detailing of the gum areas (pink resin) and tooth anatomy (tooth-coloured resin), leading to a better fit, aesthetics and function of the duplicate denture, and it also allows for easier and targeted repair of specific areas without affecting the gingival portion.[14]In this case, the patient received a high-quality backup denture with minimal discomfort and was satisfied with the results, as evidenced by his subsequent follow-up visit. However, digital techniques face challenges, particularly in local dental clinics, due to the high cost of 3D machines and the limited expertise of dental technicians in utilising digital methods.[4]

4. Conclusion

This case demonstrates the effectiveness of digital technology in meeting the needs of elderly and cognitively impaired patients, providing a practical solution for maintaining denture function and

aesthetics. As digital denture technology continues to evolve, it holds promise for enhancing the quality of care and improving patient outcomes.

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