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Case Report

Utilizing Intraoral Scanning and Computer-Aided Design/Manufacturing for Creating a New Dental Crown to Match an Existing Removable Prosthesis: A Case Report

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Abstract

This clinical report demonstrates the successful dental crown treatment for a 39-year-old female patient with a fractured posterior lower right second molar wearing a removable partial prosthesis and refusing to make a new one. The patient's preference for a new dental crown on her lower right second molar was respected, and an intraoral scanner (IOS) was employed to capture the fractured abutment's anatomy, which also serves as part of her removable denture. Following abutment preparation, a second IOS scan recorded the modified abutment. A temporary crown of the abutment was fabricated and secured to protect the prepared abutment. Comprehensive data, including an intraoral scan with an existing removable denture file, an intraoral scan without a removable denture, an intraoral scan of an unprepared abutment file, an intraoral scan of prepared abutment, and a digital photo of shade selection were transmitted to the dental laboratory. Utilizing computer-aided design/computer-aided manufacturing technology, a new dental crown compatible with the existing removable prosthesis was created. After fitting the new crown, occlusion, aesthetics, function, and attachment assessments were conducted to ensure optimal results. Subsequent follow-ups confirmed the patient's satisfaction with the functionality, aesthetics, and fit of her removable partial denture with the new dental crown.

Keywords

Digital Dentistry, Dental Crown, CAD/CAM, Crown on Existing Removable Denture, Fix Prosthodontic

1. Introduction

Designing a new crown for integration with an existing removable prosthesis presents intricate challenges for dental professionals and technicians. To address the complexity of this procedure, several approaches have been introduced, including direct methods, indirect methods [1], and direct-indirect techniques. [1-3]

Direct techniques involve intraoral acrylic resin crown modeling intraorally, while indirect methods necessitate an impression of tooth preparation and prosthesis integration. [1] Indirect-direct techniques entail adapting the inner prosthesis surface intraorally. [1-4] The growing popularity of computer-aided design/computer-aided manufacturing (CAD/CAM) technology and the widespread use of intraoral scanners (IOS) with acceptable precision [5, 6] have transformed dentistry. The recent report combines conventional polyvinylsiloxane impressions with digital IOS, laboratory scans, and

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CAD/CAM to create an all-ceramic crown retrofitting an existing removable prosthesis clasp which looks like a direct-indirect technique. [7] Thus, this clinical report elucidates the technique for achieving this using fully digital dentistry.

2. Case Report and Discussion

A 39-year-old female patient with a non-metal clasp denture worn for over 5 years presented with partial dislodgement of a resin composite restoration and her natural tooth on the lower right second molar (Figure 1). Comprehensive evaluations were performed, and all possible treatments were given to the patient including making a new dental crown together with a new removable denture or making a new dental crown with dental implants instead of a removable prosthesis. After discussing treatment options and obtaining informed consent, the patient opted for a crown restoration to address the issue.

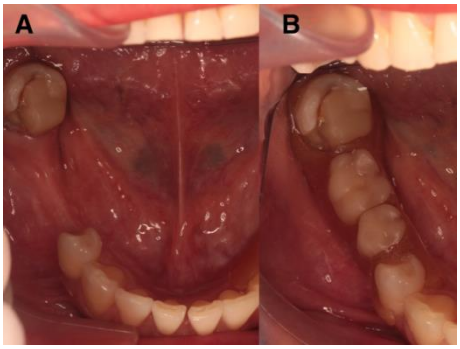

Figure 1. *Partial dislodgement of a resin composite restoration and a crown fracture: (A) without a denture, (B) with a denture.*

The treatment started with recording intraoral scans with and without the denture using an IOS (iTero™ Element 5D, Align Technology, San Jose, CA) (Figure 2(A) and (B)). A polyvinylsiloxane (PVS) putty (3M ESPE Express™ XT Putty Quick, 3M Deutschland GmbH, Germany, LOT ZP0011358), was used to duplicate the unprepared abutment tooth. The lower right second molar was then prepared for an all-ceramic restoration, and the old resin composite restoration was removed and refilled (SimpliShade™, Kerr Corporation, USA, LOT 9011034) as the resin composite core build-up. A retraction cord size 00 (Ultrapak™, Ultradent Product Int., USA, LOT BLKLP) was put into the sulcus around the prepared abutment. The final preparation was made, and a digital impression was used to record an abutment without wearing a denture (Figure 2(C)). A temporary crown was made using bis-acrylic composite resin (Luxatemp Star, DMG, Germany, LOT 237881) and silicone putty index to save time and reduce visits that patient had to come for treatment. The shade selection was made using VITA Toothguide 3D-MASTER® (VITAZahnfabrik, Germany). All stereolithography (standard triangle language, standard tessellation language, STL) and shade selection photo files were sent to a dental laboratory via the IOS portal digitally, and the crown was designed using the CAD program (TRIOS Design Studio, 3Shape, Denmark) by mimicking the contour of an unprepared abutment which fit an intaglio surface of the existing denture and also generate the rest of the full anatomic contour of a dental crown. The full zirconia crown (DD Bio ZX^2 color, Dental Direkt GmbH, Germany, LOT 6162223014) was milled by a CAM machine (Robocam, China). At the insertion visit, the temporary crown was removed and replaced by the full zirconia crown. The crown and abutment sealing were checked by using a silicone-based fitting check material (FIT CHECKER™ ADVANCE, GC Corporation, Japan). The crown was cleaned (Ivoclean, Ivoclar Vivadent, Liechtenstein, LOT Z03DZ5), silanated (Monobond® N, Ivoclar Vivadent, Liechtenstein, LOT Z02XRS), and definitively cemented with resin cement (Multilink® Speed, Ivoclar Vivadent, Liechtenstein, LOT Z02CJY) (Figure 3). A recall appointment was scheduled for the patient. After the delivery and recall visit, the patient expressed satisfaction with the functionality, aesthetics, and fit of the prosthesis. This clinical report comprehensively outlines the digital workflow for retrofitting a crown restoration to an existing removable prosthesis, with the exception of the temporary crown using a silicone index technique. [8] Nevertheless, this report demonstrates the utilization of digital dentistry techniques, such as intraoral scanners, to enhance patient comfort and replace traditional dental impressions. [9]

Digital dentistry, notably through CAD/CAM technology, has gained widespread popularity. Its benefits encompass not only enhanced patient comfort through digital impressions but also encompass the storage of digital data such as impressions, models, virtual articulators, and facebows, along with improved laboratory processes. [9-11] In contrast, traditional dental impressions entail discomfort, necessitate clinician expertise, and pose potential harm due to impression materials. For instance, materials like polyether or hydrophilic PVS, while effective in capturing abutment details, can result in a hardened impression that locks onto teeth, requiring the destruction of the impression tray and material which may be harmful to the oral tissue and the details we need. [12] Additionally, Ozawa et al. [13] demonstrated superior fitting and retention of CAD/CAM-made crowns compared to conventional methods, while Freire et al. [14] reported clinically acceptable marginal discrepancies in crowns produced via digitalization across various materials.

In this report, the patient was presented with various treatment options, including dental implants, removable partial dentures, and a dental crown. Due to economic constraints, the patient opted for a dental crown to be placed on an existing non-metal clasp denture, which had been in use for over 5 years. It is worth noting that non-metal clasp dentures, often referred to as "flexible dentures," can lose their flexibility and become rigid over time, as reported in a prior study. [15] Consequently, if the new crown did not seamlessly integrate with the existing non-metal clasp denture, it could lead to discomfort for the

patient and hinder proper denture insertion.

To simplify the process of crafting a new crown for an existing removable prosthesis without the need for intricate procedures and expert skills, digital dentistry and CAD/CAM technology offer viable alternatives. While this approach enhances production efficiency and patient satisfaction, it does pose limitations in terms of the technology's cost and the requisite education and training for dental clinicians and laboratory technicians.

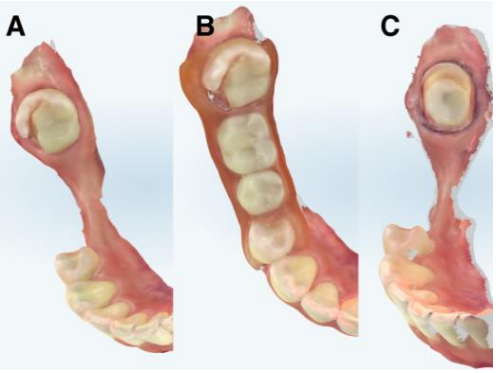

Figure 2. *A digital impression: (A) without a denture, (B) with a denture, (C) the prepared abutment.*

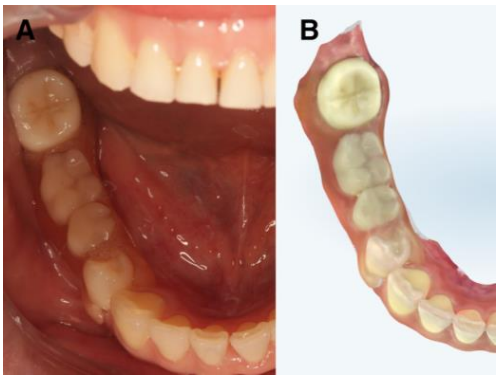

Figure 3. *(A) The new crown perfectly fits with the existing removable denture, (B) A digital impression of the new crown with an existing removable denture.*

3. Conclusions

A retrofitting prosthetic surveyed dental crown could be made with various procedures. In this report, an IOS and dental CAD/CAM technology were used to simplify fabricating a retrofitted full zirconia dental crown that is suitable for an existing removable denture. Full zirconia crown has high compressive strength, high flexural strength, and acceptable aesthetic. Dental CAD/CAM technology provides accuracy and reduces the step of making a new dental crown. The result was time-saving and very satisfying for the patient. The dental CAD/CAM technique could be considered as a novel procedure to make a retrofitted dental surveyed crown.

Abbreviations

IOS: Intraoral Scanner

CAD/CAM: Computer-Aided Design/Computer-Aided Manufacturing

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Author Contributions

Pongsakorn Apinsathanon is the sole author. The author read and approved the final manuscript.

Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Pongsakorn Apinsathanon, D.D.S., M.Sc., is a practicing dentist at PSK Dental Center, Bangkok, Thailand. Currently pursuing a Doctor of Philosophy in Prosthodontics at the Faculty of Dentistry, Chulalongkorn University. Holds a Master of Science in Dentistry, Clinical Dentistry, Prosthodontics, from the Faculty of Dentistry, Srinakharinwirot University. Completed a Bachelor of Dental Surgery from the Faculty of Dentistry, Srinakharinwirot University. Additionally, serves as a visiting lecturer at the Faculty of Dentistry, Srinakharinwirot University, delivering academic lectures and conducting clinical supervision both pre and post-graduation.

Research Field

Pongsakorn Apinsathanon: Dental Materials, Dental Polymer and Adhesive, Ceramics, Metal, Dental Implant, Digital Dentistry, Dental Pandemic, Bone Regeneration around Dental field, Dental Public Health.