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Non-Rigid Connector Fixed Dental Prosthesis Using CAD/CAM Design and 3D Printed prototype: A Case Report

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Abstract

The case report details the successful utilization of CAD/CAM technology and 3D printing in the creation of a non-rigid connector fixed partial denture (FPD) for a patient with missing mandibular left quadrant teeth (34, 35, 36, 37, and 38), with tooth 36 serving as a pier abutment. The decision to incorporate a non-rigid connector aimed to efficiently manage occlusal forces, particularly in the challenging context of a pier abutment. This approach offered notable advantages, including enhanced stress distribution, improved patient comfort, and the potential for extended prosthesis lifespan. Despite the benefits, challenges were encountered in the design and fabrication.3D printing guides of non-rigid connector were used for precision and technical expertise to address these complexities successfully. This case report emphasizes on the importance of personalized treatment planning and showcases the value of non-rigid connectors in optimizing oral function and patient satisfaction. The integration of advanced digital technologies, such as CAD/CAM and 3D printing, further highlights their potential in delivering precise and efficient restorative solutions. This case report contributes to the ongoing exploration of non-rigid connectors in complex clinical scenarios, providing insights into their role in enhancing the field of restorative dentistry.

Keywords: Nonrigid connector, CAD- CAM, 3D printing.

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1. Introduction

Fixed dental prosthesis (FDP) is a foundation in contemporary restorative dentistry, offering indispensable solutions for restoring dental arch integrity and enhancing patient's oral health and quality of life. FDP's have significantly evolved over the years, incorporating advanced technologies and materials to meet the diverse demands of patients with various clinical presentations. The significant advancements in FDP design involves the integration of non-rigid connector [1]. Unlike traditional rigid connectors, which rigidly link abutment teeth in FDPs, non-rigid connectors offer a unique and promising approach by allowing a degree of flexibility in connecting the components of the prosthesis. This flexibility plays a pivotal role in managing occlusal stresses and accommodating minor discrepancies between abutment teeth, particularly when a pier abutment is present within the dental arch [2].

The role of FDPs in dental rehabilitation extends beyond functionality [3]. These restorations address a multitude of clinical scenarios, ranging from the replacement of missing teeth to the restoration of esthetic harmony. Patients seeking FPDs often present with diverse clinical needs, and it is imperative for the clinicians to customize their treatment plans to achieve optimal outcomes. This case report discusses an intricate process of designing and fabricating a non-rigid connector fixed dental prosthesis using CAD/CAM technology and 3D printed guide. This case report aims to showcase the successful application of CAD/CAM design and 3D printing technology in the creation of a non-rigid connector FDP, demonstrating its potential to enhance the longevity and functionality of prosthetic restorations in scenarios involving pier abutments. Additionally, it emphasizes the significance of patient-centric treatment planning and the role of non-rigid connectors in managing occlusal forces and ensuring esthetic and functional harmony within the oral cavity.

2. Case presentation

The patient was an 81-year-old male, presented with a chief complaint of a missing tooth in his lower left back tooth region (34, 35, 36, 37, and 38) (Figure 1). The patient expressed concerns about impaired masticatory function and diminished aesthetics due to the absence of these teeth. The patient was seeking a replacement for the missing tooth and wanted a fixed dental prosthesis among the treatment options provided. The patient had a history of Coronary Artery Bypass Grafting (CABG) performed 5 years ago and has been diagnosed with diabetes for the past 20 years. There was no habitual history of smoking and he is a non-alcoholic. Intraoral examination revealed a partially edentulous mandibular left quadrant with missing teeth at positions 34, 35, 36, 37, and 38. Tooth 36 was identified as a pier abutment, with compromised occlusal anatomy and reduced coronal structure. This pier abutment posed a challenge due to its location and unique load-bearing characteristics. The treatment plan involved the design and fabrication of a non-rigid connector fixed dental prosthesis to replace the missing teeth in the mandibular left quadrant, with particular attention to managing the 36-pier abutment. CAD/CAM technology was employed for precise prosthesis design. Additionally, 3D printing technology was utilized to fabricate the non-rigid connector prototype to evaluate the designed FDP on the patient (Figure 3).

The tooth preparation process was made to attain the ideal abutment geometry for the prosthesis. A single step putty reline impression of mandibular arch was made. A master cast was retrieved from the impression. The maxillary and mandibular cast were articulated with interocclusal records. A Lab scanner was employed to scan the articulated cast. Non-rigid FDP was designed using the Sirona software (Fig 4). The designed prosthesis was printed and evaluated for precision intraorally on the patient. Subsequently, the prosthesis was cad milled following the precision evaluation (Fig 5). The finished prosthesis was cemented (Fig9).

3. Discussion

Non-rigid connector was chosen in this situation was driven by several key considerations. The presence of a pier abutment at tooth 36 necessitated a thoughtful approach to manage occlusal forces efficiently. Traditional rigid connectors may exert excessive stress on the pier abutment, potentially leading to complications such as abutment mobility or prosthesis failure [4]. The non-rigid connector allows for a controlled degree of movement, thereby reducing the stress concentration on the pier abutment and surrounding structures. The primary advantages of employing a non-rigid connector in this case was the ability to distribute occlusal forces [5]. This reduced the risk of overloading the pier abutment, contributing to long-term prosthesis stability. Non-rigid connectors can enhance patient comfort by minimizing the sensation of excessive forces on individual abutment teeth, leading to improved masticatory function and reduced risk of discomfort or pain. By reducing the stress placed on the pier abutment, the non-rigid connector approach has the potential to enhance the longevity of the prosthesis, reducing the need for future repairs or replacements [6]. Non-rigid connectors require precise planning and execution, which can be technically demanding for both the clinician and dental laboratory. This complexity may increase the overall treatment timeline. The non-rigid connector is designed to flex under stress, there is a risk of deformation over time. Follow-up and maintenance were done to check on any changes in the connector's integrity [7]. The use of a non-rigid connector in this case contributed significantly to effective stress management within the dental arch. By allowing slight movement of the prosthesis during functional loading, the connector distributed occlusal forces more evenly across the abutment teeth. This balanced force distribution reduced the overloading on the pier abutment (36) and mitigated the associated risks, including abutment mobility and prosthesis failure [8]. The implementation of a non-rigid connector in a fixed partial denture is not without its challenges. The primary challenge was the need for precise planning, designing and fabrication especially with a pier abutment [9]. The CAD/CAM technology (Sirona software) were utilized, allowing for meticulous design adjustments to ensure optimal stress distribution. The challenge was reduced by printing the prototype and before final milling of the FDP [10]. The printed prototype served as an essential tool for assessing the feasibility of the design before the final prosthesis was milled and cemented.The incorporation of a non-rigid connector in the fixed dental prosthesis offered distinct advantages in terms of stress management, patient comfort, and prosthesis longevity [11]. It presented challenges related to design complexity and 3D printing, these were effectively addressed through meticulous planning and execution. The case report demonstrated the potential of non-rigid connectors in managing complex clinical scenarios, particularly those involving pier abutments, thus contributing to the advancement of restorative dentistry [12].

Figure 1: Preoperative intra-oral view

Figure 2: Preoperative radiograph

Figure 3: 3-D printed prototype – intra oral

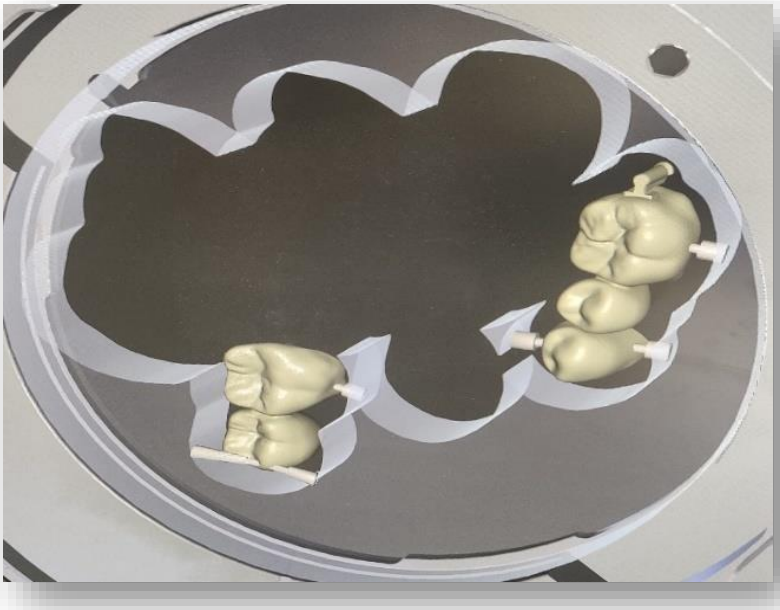

Figure 4: CAD-CAM designing

Figure 5: CAD-CAM milled prosthesis

Figure 6: Frontal view of Provisional

Figure 7: lateral view of Provisional

Figure 8: Final prosthesis in cast model

Figure 9 : Cementation of the final prosthesis

Figure 10: Post-operative Radiograph

4. Conclusions

The successful implementation of a non-rigid connector in this case facilitated an even stress distribution, enhancing patient comfort and potentially prolonging prosthesis longevity.

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