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Case Report

Surgery-Guided Periodontal Techniques for Esthetic Integration of Anterior Fixed Prostheses: A Case Report

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Abstract: ***Introduction*:** Achieving optimal esthetic integration of fixed prostheses in the anterior region requires effective periodontal management. This case report demonstrates the use of surgery-guided techniques to enhance esthetic outcomes in a prosthetic rehabilitation. ***Observation*:** A patient with insufficient clinical crown height underwent crown lengthening and subepithelial connective tissue grafting for soft tissue optimization. CAD/CAM technology was used to fabricate a provisional prosthesis, ensuring precise fit and esthetic integration. ***Discussion*:** Surgery-guided periodontal techniques, including crown lengthening and soft tissue grafting, improve esthetic outcomes by optimizing gingival contours. The use of digital workflows enhances precision, but challenges remain in managing gingival healing and achieving ideal esthetics. Further research into advanced materials and technologies could further refine this approach.

Keywords: Surgery-guided periodontal techniques, esthetic integration, fixed prostheses, anterior region, crown lengthening, CAD/CAM technology, provisional prosthesis, gingival contours.

INTRODUCTION

Achieving optimal esthetic integration of fixed prostheses in the anterior region is a fundamental challenge in modern prosthodontics. The success of anterior restorations depends not only on the shape, shade, and material of the prosthesis but also on its harmonious relationship with the surrounding periodontal tissues. A well-balanced interaction between the prosthetic restoration and the periodontium ensures a natural and lifelike appearance, contributing to patient satisfaction and long-term stability [1].

However, anatomical limitations, gingival discrepancies, or alveolar ridge defects can compromise the esthetic outcome. In such cases, pre-prosthetic periodontal surgery plays a crucial role in optimizing the soft and hard tissue framework before prosthetic rehabilitation. Various surgical procedures, such as crown lengthening, soft tissue grafting for recession coverage, and ridge augmentation for edentulous sites, can be employed to create a favorable environment for fixed prostheses. These interventions help establish proper gingival contours, improve papilla fill, and enhance the overall harmony between prosthetic and natural structures [2, 3].

With advancements in periodontal and prosthetic techniques, an interdisciplinary approach combining prosthodontics and periodontology has become essential for achieving predictable esthetic results. This article aims to illustrate, through a clinical case, the importance of pre-prosthetic periodontal surgery in ensuring the esthetic success of fixed prosthetic restorations in the anterior region.

CLINICAL CASE

A 22-year-old female patient, in good general health, presented to the Department of Dentistry at CHU Farhat Hached, Sousse, seeking an esthetic smile restoration. During the patient interview, she reported a history of a road traffic accident five years ago, which resulted in fractures of teeth 11, 21, and 22.

Clinical and Radiographic Examination at the First Consultation

The initial examination revealed good oral hygiene. Tooth 11 presented an amelodentinal fracture with dyschromia, indicating necrosis. Tooth 21 had a defective metal-ceramic crown with a post, showing a bulky form and a non-hermetic marginal fit.

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Additionally, tooth 22 had a coronal restoration with composite resin (Fig. 1, 2).

Fig. 1: Initial situation at the first consultation

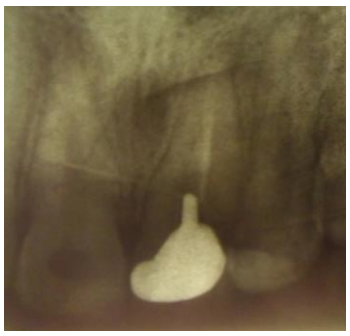

Fig. 2: Initial periapical radiograph at the consultation

After removal of the monoblock crown, an oblique crown-root fracture (extending beyond the cervical third) was found (Fig. 3).

Fig. 3: Removed monoblock crown

To optimize the esthetic and functional outcomes, a series of pre-prosthetic procedures were performed. First, endodontic treatment was completed on tooth 11, followed by internal bleaching and composite resin restoration. Due to the poor prognosis of tooth 21, the existing crown was removed, and after evaluating the remaining structure, extraction was performed. Subsequently, teeth 11 and 22 were prepared, and a first-generation provisional prosthesis was placed based on the esthetic analysis using Digital Smile Design (DSD) (Fig. 4, 5).

Fig. 4: Two weeks after the extraction of tooth 21

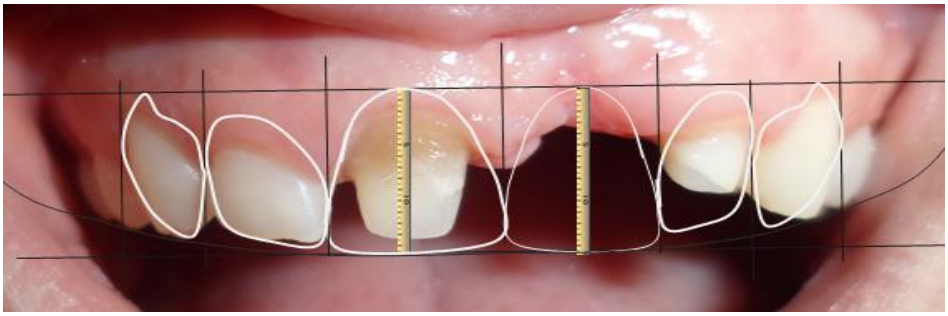

Fig. 5: Digital simulation of the prosthetic plan

To optimize the esthetic outcome in this case, several critical pre-prosthetic steps were carefully planned and executed. The patient presented with a vestibular depression at the site of tooth 11, which affected the overall esthetics of the smile. To correct this, a subepithelial connective tissue graft was performed. This surgical procedure aimed to add volume to the gingival tissue, providing better support for the future prosthetic restoration.

Additionally, the incisor-canine region presented a challenge due to reduced clinical crown height, which could potentially compromise the esthetic results and the function of the final restoration. To address this, a crown lengthening procedure was necessary.

The gingivectomy level was meticulously determined using a thermoformed guide, which was designed based on the Digital Smile Design (DSD) principles. DSD is a powerful tool in digital esthetic planning, allowing for a precise and predictable approach to treatment. The guide, created with the help of CAD/CAM technology, ensured that the surgical intervention adhered to the esthetic parameters defined in the digital mock-up, particularly in terms of the gingival line, the positioning of the teeth, and the overall harmony of the smile (Fig. 6, 7, 8).

a b c

Fig 6-a: modified wax-ups
Fig6-b: Plaster duplicate of the maxillary model + antagonist
Fig6-c: A soft resin splint made by thermoforming on the plaster cast

a b

Fig. 7(a-b): Determination of the gingivectomy level guided by the splint

Fig. 8: Palatal graft

A CAD/CAM-fabricated temporary prosthesis was then placed to guide periodontal healing and maintain both esthetic and functional integrity (Fig. 9).

Fig. 9: PMMA temporary bridge

Following a three-month healing period with the provisional prosthesis, the final treatment decision was made (Fig. 10).

Fig. 10: Three months after the placement of the temporary prosthesis

Although implant placement would have been the ideal option for replacing the missing tooth, the patient declined this approach due to financial constraints. As a result, a ceramic-ceramic bridge was chosen as the definitive prosthetic solution. This approach provided an esthetically and functionally satisfactory outcome while respecting the patient's financial limitations.

DISCUSSION

Achieving a natural dentogingival esthetic outcome in fixed prosthodontics, whether on natural or implant-supported abutments, requires careful consideration of multiple factors. The stability and health of the marginal tissues are essential, with interventions focusing on reinforcing thin gingival biotypes, treating gingival dyschromia, and harmonizing the gingival line. Moreover, the presence of well-defined interdental papillae plays a crucial role in ensuring the seamless integration of the prosthesis into the natural dentition. These factors work together to ensure that the final restoration is not only functional but also visually harmonious with the surrounding tissues, providing a balanced and esthetically pleasing result [4-6].

One of the critical steps in achieving optimal peri-prosthetic tissue healing is the use of a provisional prosthesis. This transitional phase allows for soft tissue maturation, adaptation, and stabilization before the final restoration is placed. The provisional restoration enables the evaluation of both the aesthetic and functional aspects of the design, ensuring that the gingival tissues adapt appropriately to the planned prosthesis. Traditionally, these provisional restorations are fabricated in the laboratory using heat-polymerized resins, but with the advancements in digital dentistry, the use of computer-aided design and computer-aided manufacturing (CAD/CAM) technology has significantly transformed the fabrication process [7, 8].

Modern provisional prostheses can now be milled from high-density polymethyl methacrylate (PMMA) discs or blocks. This material offers superior biological compatibility, enhanced mechanical properties, and improved esthetic outcomes compared to traditional resins. PMMA, as a high-density polymer, ensures that the provisional restoration is more resistant to wear and staining, thus prolonging its functionality during the healing phase. The precision of CAD/CAM fabrication ensures better marginal adaptation, reducing the risk of bacterial infiltration and enhancing the overall treatment predictability. These advancements in digital workflows enable clinicians to have greater control over the final outcome, improving patient satisfaction and clinical success [9-11].

The integration of a Digital Smile Design (DSD) approach further refines the treatment process. By utilizing a virtual patient model, the clinician can simulate the final restoration's esthetic outcome, thus guiding the surgical and restorative phases. In the current case, DSD was used to determine the appropriate esthetic parameters for the restoration, ensuring optimal results and guiding the clinician throughout the procedure. Moreover, surgery-guided virtual planning via DSD allows for precise interventions, ensuring that both the soft and hard tissues are managed to align with the desired esthetic goals [12, 13].

Despite the significant advantages of CAD/CAM technology in provisional restoration fabrication, several limitations remain. While PMMA offers excellent mechanical properties, it is still more prone to fracture than materials used for final restorations, such as lithium disilicate or zirconia. Therefore, care must be taken to avoid excessive stress during the provisional phase. Furthermore, despite the precision offered by digital workflows, they still require the operator to be proficient in both the technical and clinical aspects of the process. Any inaccuracies during the scanning or design phase may lead to fit or aesthetic issues with the final restoration [14-16].

Another limitation involves the difficulty of adjusting the gingival contour using CAD/CAM provisional restorations. Although these restorations offer a high degree of precision in fit, achieving the exact gingival line necessary for optimal esthetics may still depend on the clinician's manual skills. The gingival tissues surrounding the prepared teeth may require additional contouring, either through manual adjustments to the provisional or through soft tissue management techniques.

Proposal for Further Consideration

Given the limitations of current materials and technology, further research into more advanced materials for provisional restorations could provide better alternatives. Newer, more durable polymers with superior mechanical properties could be developed to withstand the rigors of long-term use before final restoration placement. Furthermore, advancements in gingival contour management could assist clinicians in guiding soft tissue healing more effectively and improving the overall esthetic outcome.

Another potential development lies in integrating augmented reality (AR) or artificial intelligence (AI) with CAD/CAM systems. These technologies could assist clinicians in visualizing the gingival response to provisional restorations in real-time, enabling faster and more accurate adjustments to the provisional design. Additionally, incorporating patient-specific data, such as gingival biotype and healing potential, could facilitate more personalized provisional restorations that better predict and guide the final prosthetic design, leading to more accurate, functional, and esthetically pleasing outcomes.

CONCLUSION

In conclusion, the integration of digital workflows and high-performance materials in prosthodontics significantly enhances both functional and esthetic outcomes. The use of CAD/CAM-fabricated PMMA provisional restorations plays a crucial role in guiding periodontal healing, ensuring optimal conditions for the final prosthetic rehabilitation. These advancements have increased treatment predictability, improved the precision of prosthetic designs, and contributed to more favorable clinical outcomes. However, further research and technological advancements are needed to continue refining this process, improving both material properties and clinical techniques to further enhance patient satisfaction and long-term success.

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