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Case Report

Bridging Function and Esthetics: A Multidisciplinary Approach to Esthetic Rehabilitation with a Pier Abutment

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Abstract

Background:
Restoration of partially edentulous arches in middle-aged patients with multiple missing teeth and aesthetic concerns presents a significant prosthodontic challenge. Management of pier abutments is crucial to prevent stress accumulation and potential prosthetic failure. PFM Crowns offer superior aesthetics and functional durability.

Case Presentation:
A 52-year-old female presented with missing maxillary teeth and dissatisfaction with her smile. Clinical examination revealed worn anterior teeth, missing premolars, and adequate alveolar support. The patient underwent full upper arch rehabilitation using segmental fixed partial dentures (FPDs) with PFM Crowns, guided by a comprehensive digital and conventional smile design protocol.

Intervention:
The treatment included diagnostic wax-up, digital smile design, tooth preparation, impression-making, provisional restorations, and cementation of definitive PFM Crowns. Occlusion was verified, aesthetics optimized, and functional guidance established.

Outcome:
The rehabilitation restored aesthetics, occlusion, and masticatory function. Patient satisfaction was high, and follow-up demonstrated stable prostheses and healthy soft tissue response.

Conclusion:
This case demonstrates that careful pier abutment management, segmental FPD design, and incorporation of smile design principles using PFM Crowns can achieve predictable functional and aesthetic outcomes.

Keywords: *Pier abutment, PFM crowns, Digital smile designing, Mutually protected occlusion.*

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Introduction

Tooth loss is a prevalent dental condition in adults, with multiple etiologies including dental caries, periodontal disease, trauma, and failed restorations. Epidemiological studies indicate that partial edentulism affects a significant proportion of adults over 50 years, impacting not only mastication and phonetics but also facial aesthetics, self-esteem, and overall quality of life [1,2]. The anterior maxillary teeth are particularly critical for smile aesthetics, while the posterior teeth are essential for occlusal function and masticatory efficiency. Consequently, rehabilitation of partially edentulous maxillary arches requires an approach that addresses both functional and aesthetic demands simultaneously.

A pier abutment refers to a natural tooth located between two edentulous spans, serving as a key abutment for multiple pontics in a fixed partial denture (FPD). While providing support, pier abutments introduce biomechanical challenges due to differential movement of terminal abutments during functional loading. Excessive stress at the connectors or the pier abutment can result in prosthesis failure, marginal leakage, cement loss, or fracture of the connectors [3,4]. Careful planning, including segmentation of the FPD and the use of non-rigid connectors on either side of the pier, is critical to distributing occlusal forces and ensuring longevity of the restoration [5].

For many years, the most predictable and durable aesthetic restoration of anterior teeth has been achieved with full-coverage PFM crowns. Even though cutting of the tooth substance is more and metal display is concern, porcelain fused to metal restoration has many advantages related to recovering esthetics of the grossly carious and discolored teeth which requires reinforcement along with esthetics. They demonstrate excellent clinical performance in terms of strength, longevity, and biocompatibility and most importantly affordable to most patients.

Modern prosthodontics emphasizes the integration of digital smile design and patient-centered aesthetic planning. Digital and conventional diagnostic tools allow clinicians to pre-visualize outcomes, adjust tooth proportion, midline position, gingival display, and smile arc, and communicate treatment plans effectively to patients. Such tools help ensure that functional rehabilitation is harmonized with aesthetic expectations, improving patient satisfaction and psychosocial outcomes [7,8].

Full upper arch rehabilitation, particularly in patients with pier abutments, thus requires a multidisciplinary approach, incorporating principles of biomechanics, material science, occlusion, and aesthetic planning. Despite advancements in materials and techniques, challenges persist in achieving long-term stability, particularly in cases involving multiple missing teeth, worn dentition, and unesthetic smiles.

This case report presents a distinct approach to full upper arch rehabilitation in a 52-year-old female patient with multiple missing teeth and a pier abutment scenario. The report highlights the integration of biomechanical considerations, segmental FPD design, PFM- restorations, and digital smile design to achieve optimal functional and aesthetic outcomes.

Case Report

A 52-year-old female patient reported to our institute's Department of Prosthodontics and Implantology clinic with concerns related to poor aesthetics and difficulty in mastication in the upper jaw. Her primary expectations included the restoration of a natural-looking smile and the replacement of missing teeth to improve function.

The patient was medically fit, with no significant systemic conditions or contraindications to dental treatment. She was a non-smoker and reported no history of parafunctional habits such as bruxism.

On extraoral examination, the patient demonstrated a square face type, diminished vertical dimension of the lower face, and an inverted smile line (Figure 1). Intraoral examination revealed partial edentulism in the maxillary arch, specifically the absence of the right maxillary lateral incisor, right maxillary second premolar, left maxillary first premolar and left maxillary first molar (Figure 2a). The remaining dentition exhibited generalized attrition (Figure 2b). Periodontal evaluation revealed adequate bone support and good oral hygiene with no active periodontal disease.

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Figure 1: Pre-interventional extraoral photographs (a) Front view (b) Side view

Figure 2: Pre-interventional intraoral photographs (a) maxillary arch occlusal view (b) Frontal view

A diagnostic evaluation, including radiographs and diagnostic impressions, was performed. A panoramic radiograph confirmed the presence of adequate bone support for the abutment teeth and revealed no signs of pathology. A digital smile design was completed to assess aesthetic requirements and plan the final outcome in line with the patient's expectations.

Prior to intervention, patient consent was obtained and she was educated about the treatment plan. The treatment plan included the fabrication of a fixed dental prosthesis (FDP) using a pier abutment configuration. The maxillary left canine, maxillary left second premolar, along with the maxillary left molar, were selected as abutment teeth. The maxillary left second premolar served as the pier abutment between the edentulous spans. Tooth preparations were carried out for full-coverage ceramic crowns on the selected abutment (Figure 3).

Figure 3: Maxillary occlusal view of tooth preparations for receiving PFM restoration

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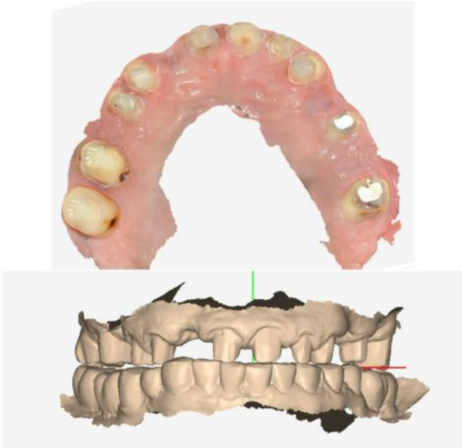

Figure 4: Digital scanning of impression to prepare virtual model

Following tooth preparation, provisional restorations were fabricated to evaluate function and aesthetics. Digital impression was registered using intraoral scanner (Runyes 3D intraoral scanner, Runyes Medical Instrument Co. Ltd., Ningbo, China) (Figure 4). Metal trial and bite registration was done (Aluwax, Michigan, U.S.A) (Figure 5). Full-contour PFM-crowns were designed and milled using CAD/CAM technology (Figure 6) The pier abutment configuration was managed with a non-rigid connector placed distal to the pier abutment to compensate for minor movements and reduce stress transmission (Figure 7).

Figure 5: Metal trial and bite-registration for PFM

The final restorations were evaluated for fit, occlusion, and aesthetics before being permanently cemented using resin-modified glass ionomer cement (Figure 8). Post-operative instructions were provided, and the patient was scheduled for periodic follow-up.

Figure 6: Definitive prosthesis

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Figure 7: Non-rigid connector on Pier-abutment

Figure 8: Intraoral photographs of final prosthesis after cementation (a) Maxillary occlusal view of anterior portion with male portion (b) maxillary occlusal view (c) frontal view

Figure 9: Post-interventional extraoral photographs (a) front profile (b) side profile (c) close-up view

A follow-up questionnaire, using a visual analog scale (VAS) from −100% (unsatisfactory) to +100% (completely satisfies), was used to assess treatment outcome. The patient's response was "+100%," confirming the intervention's success [9]. The patient expressed high satisfaction with the functional and aesthetic results. Follow-up at three and six months showed excellent soft tissue response, stable occlusion, and no signs of prosthesis failure or discomfort. (Figure 9).

Discussion

Rigid connectors are generally preferred in fixed dental prostheses because of their simplicity in fabrication. However, in cases involving pier abutments, the central pier can act as a fulcrum, creating unfavourable stress distribution. In such situations, a non-rigid connector may be indicated to function as a stress breaker, since the use of a rigid connector in pier abutment FPDs often results in increased debonding and dislodgement forces. Nevertheless, the application of non-rigid connectors should be judicious, as they are contraindicated in cases with abutments showing marked mobility, when the edentulous spans adjacent to the pier exceed one tooth, or when the opposing dentition consists of a combination of natural teeth/fixed prostheses and edentulous ridges/removable prostheses [10].

Non-rigid connectors act as stress breakers, protecting the abutment teeth by minimizing the transmission of detrimental forces. In contrast, when abutments are splinted with rigid connectors, mesiodistal flexure can occur, leading to concentrated stresses on the abutment surfaces and eventual failure of the prosthesis [11]. In cases with a pier abutment, functional forces are directed toward the terminal retainers, while the central abutment behaves like a fulcrum, predisposing the weaker retainer to failure [11]. This risk can be reduced in a five-unit fixed partial denture by incorporating a non-rigid connector at the pier site, which helps redistribute stresses more favourably [12].

The longevity of a fixed partial denture (FPD) largely depends on the appropriate selection of connectors. The indications and contraindications of non-rigid connectors are demonstrated in Table 1 [13,14].

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Table 1. Indications and Contraindications of non-rigid connectors in fixed partial dentures

Indications	Contraindications
Presence of pier abutments where fulcrum-like action may cause intrusion of central abutment and failure of terminal retainers	Marked mobility of abutment teeth
Misaligned abutments where parallel preparation may risk pulpal devitalization	Edentulous spans > one tooth, which transmit destructive stresses to retainers
Long-span FPDs where porcelain shrinkage or framework contraction may distort fit	When opposing dentition includes a mix of natural teeth/fixed prosthesis and removable prosthesis, leading to uneven stress distribution
Mandibular flexure during opening/closing, especially in anterior or posterior segments	Cases where occlusal stability cannot be achieved
Variability in retentive capacity of abutments	Situations requiring maximum splinting of abutments

According to Shillingburg et al., the non-rigid connector in a five-unit pier abutment restoration should be placed on the central abutment, as locating it on a terminal abutment may cause the pontic to function as a lever arm. The design requires that the key be incorporated on the mesial surface of the distal pontic, while the keyway should be positioned within the normal distal contour of the pier abutment. Since the long axes of posterior teeth generally incline mesially, vertical occlusal forces further encourage mesial movement. Placement of the keyway on the distal aspect of the pier abutment ensures that such mesial movement results in a more secure seating of the key within the connector [14].

This concept is further validated by the finite element analysis conducted by Oruc et al. [12], which demonstrated that incorporating a non-rigid connector distal to the second premolar reduced peak stress concentrations within the pier abutment. In contrast, Markley cautioned against placing a non-rigid connector directly on the pier abutment, as this could overload the premolar abutment, which is structurally weaker [15]. Gill proposed an alternative approach, suggesting the placement of a non-rigid connector on one or both sides of the pier abutment [16]. Adams further refined this idea by recommending positioning the connector on the distal surface of the pier and, when required, adding an additional connector to the distal surface of the anterior retainer [17].

Conclusion

Careful planning of connector design is vital for the long-term success of FDPs in cases involving pier abutments. Non-rigid connectors, when appropriately positioned, serve as effective stress breakers, improving biomechanical stability and clinical outcomes. This case demonstrates that integrating biomechanical principles with esthetic smile design and advanced restorative materials can deliver predictable functional and esthetic rehabilitation in complex clinical scenarios.

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