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Fixed Yet Flexible: Non-Rigid Connector Strategy for Pier Abutments – A Case Report

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Case Study

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ABSTRACT

Introduction: Pier abutments, located between two edentulous spaces, pose unique biomechanical challenges in fixed prosthodontics. Conventional fixed partial dentures (FPDs) with rigid connectors are often unsuccessful in such cases due to the fulcrum effect, which can lead to prosthesis failure. Non-rigid connectors are a proven solution that allows limited movement within the prosthesis, reducing stress on abutment teeth.

Case Presentation: This case report presents a 29-year-old male patient with missing right maxillary canine and second premolar. The first premolar served as a pier abutment between the edentulous spaces. Clinical and radiographic evaluations confirmed the abutments were periodontally sound. A new prosthetic plan was executed using a porcelain-fused-to-metal FPD incorporating a non-rigid key-keyway connector. The key (male) was placed on the distal surface of the pier abutment, and the keyway (female) on the mesial surface of the pontic replacing the second premolar.

Conclusion: Non-rigid connectors are essential in managing pier abutment cases to reduce stress and enhance prosthetic longevity. This case reinforces the value of biomechanically sound prosthodontic design in achieving long-term success.

Keywords: Biomechanics, Fixed Dental Prosthesis, Non-rigid Connector, Pier Abutment, Tenon-mortise.

Introduction

Managing partially edentulous arches can become particularly complex when a pier abutment is present. A pier abutment refers to a natural tooth positioned between two edentulous spaces, a situation frequently observed when both the first premolar and first molar are missing. This intermediate abutment introduces unique biomechanical challenges during prosthetic rehabilitation, especially with fixed partial dentures (FPDs).

Using rigid connectors in such cases can lead to complications. Functional forces may cause the pier abutment to behave like a pivot point, resulting in the flexing of the prosthesis. This action can cause stress to accumulate at the connectors and often leads to debonding of retainers, marginal gaps, and ultimately, failure of the restoration.[1–3]

To overcome these drawbacks, non-rigid connectors—such as the key and keyway (tenon-mortise) systems—are commonly recommended. These connectors serve as stress relievers by allowing slight movement between the prosthetic segments. This flexibility accommodates the natural movement of teeth, redistributes occlusal forces more evenly, and minimizes stress concentration on any single abutment.[4–6]

This article highlights the biomechanical considerations associated with pier abutments and reviews current best practices for their management, focusing on the use of non-rigid connectors for effective stress distribution and clinical success.

Case Report

A 29-year-old male patient reported to the Department of Prosthodontics with a chief complaint of difficulty in chewing and dissatisfaction with the appearance of his existing dental prosthesis. The dental history revealed previous extractions of the right maxillary canine and second premolar due to caries.

Upon intraoral examination, the patient was found to be missing the right maxillary canine[13] and second premolar.[15] The right maxillary lateral incisor[12] and first molar[16] were present and clinically sound. The right maxillary first premolar[14] was located between the two edentulous spaces and functioned as a pier abutment. Radiographic assessment revealed that the abutment teeth exhibited favourable crown-to-root ratios, showed no signs of periapical pathology or periodontal compromise, and had adequate supporting alveolar bone.

Considering the biomechanical challenges associated with a pier abutment, it was determined that a fixed partial denture incorporating a non-rigid connector would be the most appropriate treatment approach. A key-and-keyway (tenon-mortise) connector system was chosen to manage differential tooth movement and reduce stress on the prosthesis. The key (male component) was designed to be placed on the distal surface of the pier abutment (tooth 14), while the keyway (female component) was positioned on the mesial side of the pontic replacing the second premolar.[15] The entire prosthesis was planned using porcelain-fused-to-metal (PFM) restorations to ensure strength, function, and esthetics.

Tooth preparation was carried out on teeth 12, 14, and 16, with attention given to achieving proper axial alignment and sufficient clearance. Gingival tissues were retracted using a retraction cord, and final impressions were taken using a two-step putty-wash technique with the addition of silicone impression material. Provisional restorations were fabricated with tooth-colored auto-polymerizing acrylic resin and temporarily cemented.

In the laboratory phase, the master cast was surveyed to determine the optimal orientation for the non-rigid connector. Wax patterns were created, and a prefabricated semi-precision attachment (Preci-Vertix Standard, Alphadent NV, Belgium) was incorporated into the framework design. The PFM units were cast and completed with ceramic layering. During clinical try-in, both the metal substructures and ceramic restorations were evaluated for marginal adaptation, occlusion, and esthetics. Once verified, the final prosthesis was luted in place using glass ionomer cement. The procedure was completed without complications, and the patient was scheduled for periodic reviews to assess functional performance and long-term success.

Discussion

The presence of a pier abutment, an intermediate abutment flanked by edentulous spaces on both sides, introduces unique biomechanical challenges during fixed partial denture (FPD) rehabilitation. Rigid connectors, though traditionally favored for their stability and strength, are less ideal in such configurations. When occlusal forces are applied to one terminal abutment, the pier abutment may act as a fulcrum, resulting in rocking movements and stress concentration, which can lead to failure of the terminal retainers or debonding of the prosthesis.[2,4]

Numerous studies and clinical reports have emphasized the advantages of incorporating non-rigid connectors in pier abutment situations. These connectors function as stress breakers, absorbing and redirecting occlusal loads in a manner that permits physiologic tooth movement and prevents harmful torque forces from compromising the integrity of the prosthesis.[5,7] A commonly utilized design is the key-keyway or tenon-mortise configuration, wherein the matrix is typically placed on the distal aspect of the pier abutment and the patrix on the mesial of the adjacent pontic. This orientation facilitates passive movement and minimizes tensile forces at the retainer-abutment interface.[6,9]

Clinical evidence supports the effectiveness of this approach. Cases employing semi-precision attachments or digitally designed non-rigid connectors have shown favorable outcomes in terms of longevity, marginal adaptation, and patient satisfaction.[8,10]

Contraindications for non-rigid connectors must also be carefully considered. These include significant mobility of abutments, excessively long edentulous spans, or situations with opposing removable prostheses that may introduce unfavorable occlusal dynamics.[2] Nonetheless, when properly indicated, non-rigid connectors remain a cornerstone of biomechanically sound FPD designs in pier abutment scenarios.

Conclusion

Managing pier abutments in fixed prosthodontics requires a comprehensive understanding of the biomechanical implications associated with this unique clinical situation. Rigid connectors, although traditionally used in FPDs, often result in stress concentration and prosthesis failure when applied to pier abutment cases due to fulcrum effects and tooth movement.

The use of non-rigid connectors, particularly the key-keyway (tenon-mortise) design, has proven to be an effective solution. These connectors allow for controlled prosthesis movement, act as stress breakers, and help in distributing occlusal forces more evenly across the abutments. Clinical evidence from various case reports supports their efficacy in improving prosthetic longevity, functional efficiency, and patient comfort.

However, successful rehabilitation depends not only on connector design but also on meticulous diagnosis, individualized treatment planning, and careful selection of abutment teeth. Non-rigid connectors should be considered a standard option in fixed dental prostheses involving pier abutments, particularly in long-span restorations, to ensure biomechanical balance and long-term success.

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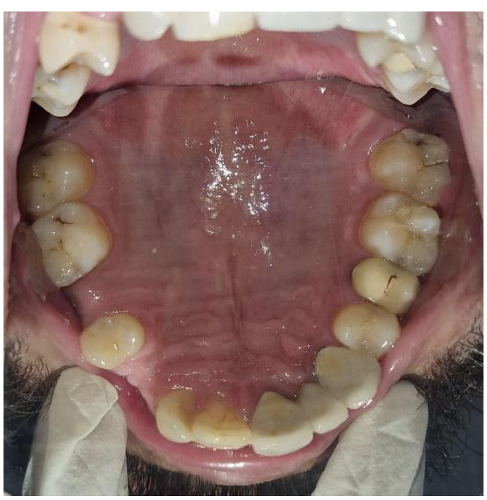

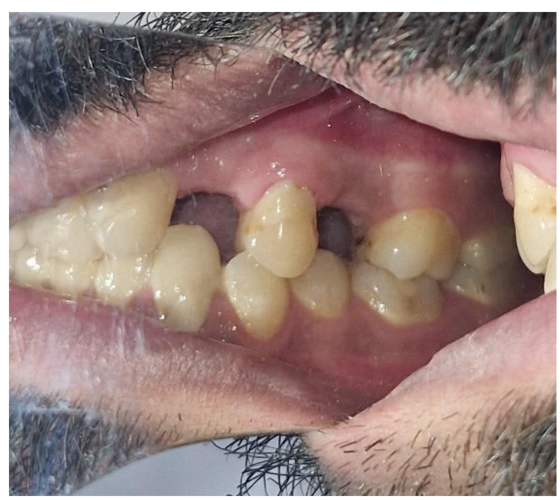

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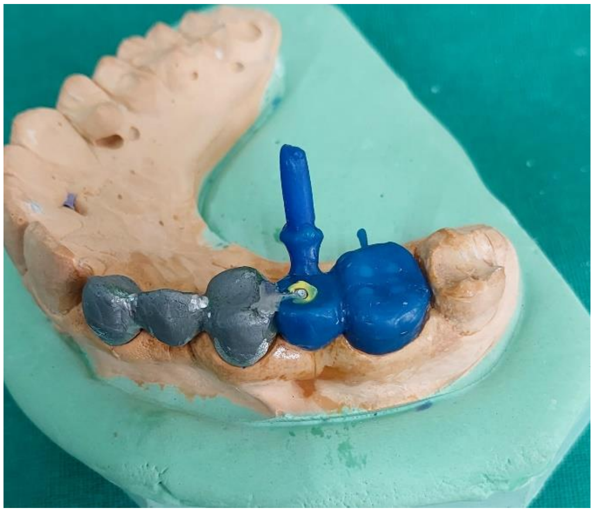

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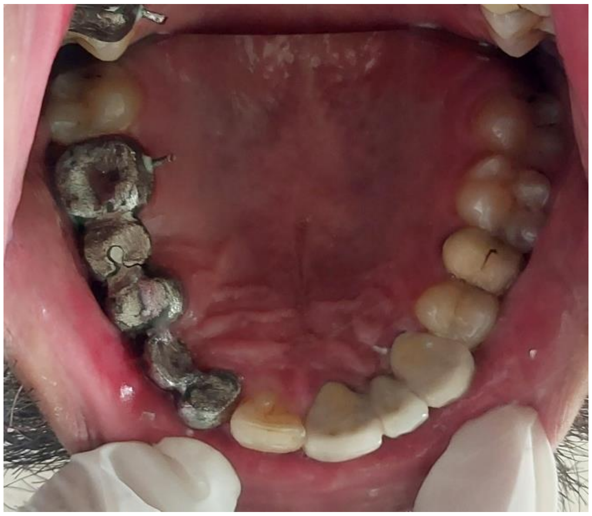

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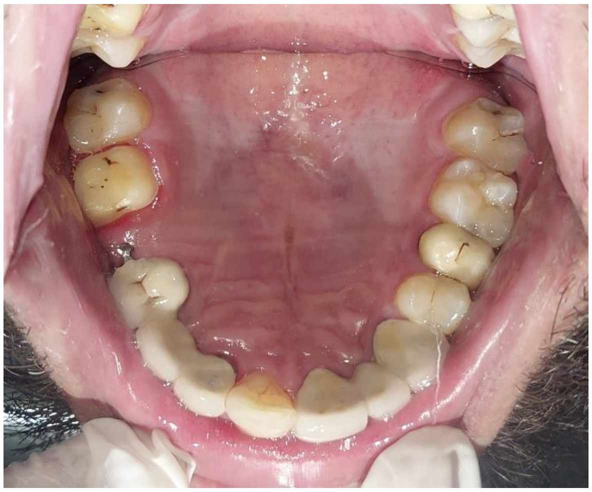

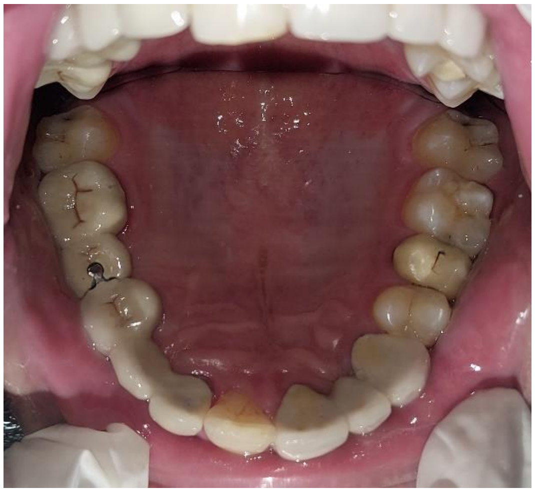

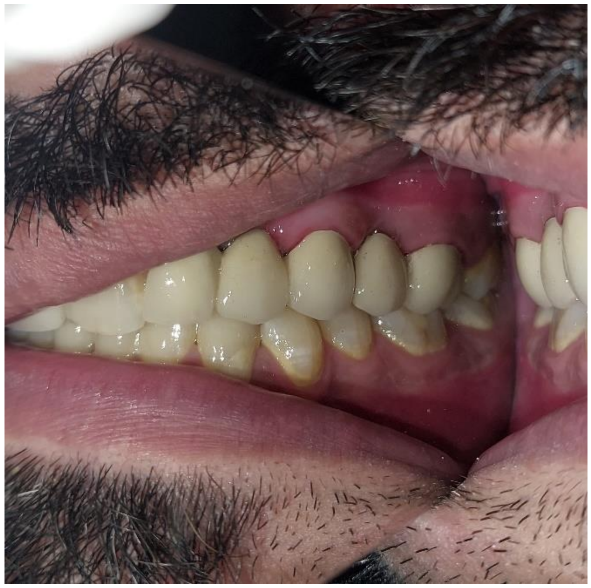

Post-op