Case Report

Precision Attachment System Incorporated in A Pier Abutment Situation – A Case Report

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Abstract: In fixed prosthodontics, issues arise when dealing with certain situations, such as pier and tilted abutments, as rigid connectors may not be suitable. Pier abutments are terminal between natural teeth, supporting fixed or removable dental prostheses. FPD connectors are components that connect the retainer and pontic. This study aimed to optimize retention and address long-span edentulism adjacent to the pier abutment. The patient's medical history was not significant, but their dental history revealed extraction of a severely decayed left maxillary second premolar and first and second molars two years ago. A conventional eight-unit FPD with rigid connectors was placed, but it dislodged multiple times within two years. Rigid connectors in this situation would cause the pier abutment to act as a fulcrum due to tooth movement, arch position, and retainer retention. A non-rigid connector was incorporated into the fixed dental prosthesis to address this issue. The use of a non-rigid connector is preferred in constructing an FPD with a pier abutment was the aim of this study. The methodology followed was by placing the keyway on the distal side of the pier abutment aids seating the key and reducing the risk of dislodgment. Placing the keyway too close to the pier abutment can loosen the key, potentially damaging the canine retainer or causing bone loss around the canine abutment. Non-rigid connectors transfer less stress to abutments and allow for physiologic tooth movement. The design and passive fit of non-rigid connectors are crucial for the success of a long-span FPD. The appropriate connector type is selected during prosthesis construction to prevent separation and failure of the FPD. A non-rigid connector enables movement within the FPD and distributes pressures away from the pier abutment. Therefore, selecting the right architectural design, such as using a key and keyway, holds paramount importance in pier abutment scenarios and plays a crucial role in the overall effectiveness of the Fixed Partial Denture (FPD) treatment. This case study intends to delve into applying a key and keyway as a flexible connector for restoring a patient dealing with a pier abutment condition.

Keywords: Fixed dental prosthesis, Attachments, Precision Attachment, Pier abutment, non-rigid connector

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1. **INTRODUCTION**

The precision attachment denture has long been considered advantageous in dentistry as it combines fixed and removable prosthetics in such a way as to create the most esthetic partial denture possible.¹ The first line of treatment for replacing missing teeth has traditionally been fixed partial dentures. The abutment teeth, pontic design retainer, connector, and durability of the edentulous span are all important factors in the success of fixed partial dentures (FPD). The most recommended way to construct FPD is using rigid connectors. However, a completely rigid repair is not recommended in some clinical situations, such as Pier abutments.² A natural tooth in between terminal abutments is known as an intermediate or pier abutment, and it supports a fixed or portable dental prosthesis.³ An FPD with the pontic firmly fastened to the retainer gives the prosthesis the necessary strength and stability while reducing restoration-related stresses. A five-unit FPD, however, may not be the best option for the treatment of an edentulous space forms on both sides of a tooth, forming a pier abutment due to physiologic tooth movement, the position of the abutment in the arch, and a variation in the retentive ability of the retainers.⁴ Because of the curvature of the arch, the facio-lingual movement of the anterior tooth occurs at a considerable angle to the facio-lingual movement of the molar tooth. These movements can create stress on the abutments in long-span prostheses. A non-rigid connector, a stress-breaking mechanical union of retainer and pontic, is usually recommended in such a situation.⁵ Unusual stress concentration in an FPD is caused by biomechanical factors such as overload, leverage, torque, and flexing. The prosthetic connectors and the cervical dentin region are where stress is concentrated next to the edentulous ridge. Additionally, this element is crucial to the long-span FPD’s failure. The part of the FPDs called connectors joins the retainers and pontics together. Rigid and nonrigid connectors are the two types that exist.⁶ When an occlusal load is applied to the retainer on the abutment tooth at 1 end of a fixed partial denture with a pier abutment, the pier abutment may act as a fulcrum. Thus, tensile forces may be generated between the retainer and abutment at the other end of the restoration. Anterior or posterior abutments may experience extrusive forces during fulcrum action. The resultant tensile force at the retainer to abutment interface may result in potential loss of retention for these restorations.⁶ Different processes, like casting, soldering, and welding, create rigid connectors. Wax patterns must be used to shape the cast connections appropriately. The nonrigid connector is the one that allows some movement among the otherwise independent FPD elements. The prefabricated plastic designs, a bespoke milling machine, or the integration of prefabricated inserts might all be used to create the non-rigid connector.⁴

2. **CASE REPORT**

A 45-year-old male patient was reported to the Department of Prosthodontics of Sharad Pawar Dental College and Hospital, Wardha, with a chief complaint of dislodged prosthesis, difficulty in mastication, and aesthetic problems.

2.1. **Medical History and Family History**

Past medical history was significant, and past dental history revealed that the patient had undergone extraction of the badly carious left maxillary second premolar and first and second molar two years back, followed by conventional eight-unit FPD with rigid connectors; this FPD dislodged several times in two years. Family history is not significant.

2.2. **Observation**

On Intraoral examination as seen in Figure 1, it revealed missing left maxillary canine, second premolar, and maxillary first and second molar with left maxillary lateral incisor and left maxillary third molar acting as terminal abutments and first premolar acting as a pier abutment. Tooth-colored filling seen with maxillary left first premolar and maxillary third molar.

Fig 1: Intraoral examination showing missing 23, 25, 26, and 27 in maxillary arch.
2.3. Special Tests and Investigations and Diagnosis

On radiographic evaluation, the abutment teeth had adequate bone support to be used as abutment. After discussing all the treatment options and their pros and cons, it was decided to rehabilitate the case with a unit FPD using non-rigid connectors on the distal aspect of a pier abutment. Its risks and benefits were explained to the patient, and written, informed consent was obtained.

2.4. Prognosis, Treatment plan, and step-by-step Clinical procedure

The prognosis of the case was good, and further treatment procedure was carried out. The following clinical step-by-step procedure was carried out for his oral rehabilitation,

1. To enhance aesthetics, tooth preparation was modified for porcelain fused to metal prosthesis on the left maxillary lateral incisor and maxillary first premolar with equigingival margins and shoulder finish line.
2. Figure 2 illustrates tooth preparation modification for full metal coverage on the left maxillary third molar with supragingival margin and chamfer finish line. The gingival retraction was carried out with a gingival retraction cord, and final impressions were made using elastomeric impression material with a step putty wash technique.²

Fig 2: Final Impression made using elastomeric impression material.

3. An interocclusal record was made using bite registration material. Provisional restorations were fabricated with a tooth color auto-polymerizing acrylic resin and cemented with non-eugenol temporary cement. The impression was poured into a type IV dental stone. The master cast was retrieved, and die-cutting was done. Master casts were mounted on an articulator using interocclusal records.
4. The wax pattern was fabricated, and then the recess for the female was cut accordingly to fit the prefabricated plastic dovetail on the distal aspect of the pier abutment. Surveying was done to determine the position and parallelism of the plastic dovetail; the plastic dovetail female was placed within the correct contour of the pier abutment. The casting of the male pattern was carried out.
5. Figure 3 depicts the fabrication of a complete PFM bridge with matrix and patrix with the retentive sleeve incorporated.

Fig 3: PFM bridge with matrix and patrix with the retentive sleeve incorporated.

6. During cementation, the anterior three-unit segment with a keyway was cemented first, followed by the cementation of the posterior two-unit segment with a key using glass ionomer cement, as seen in Figure 4.

Fig 4: Cementation of the FPD.
The patient was instructed to maintain proper oral hygiene. The use of dental floss and interdental brush was recommended. The patient was evaluated after one week to assess the oral hygiene status.

3. DISCUSSION

Conventional rigid connectors are the preferred way of fabrication of FDP because the rigidity of the connection between the pontic and the retainers provides desirable strength and stability to the prosthesis while minimizing the stresses associated with the restoration. However, this solution is only applicable in some scenarios. According to Schillinburg et al., every restoration must withstand the constant functional and parafunctional forces to which it is subjected. This is of particular significance when designing and fabricating an FPD since the forces normally absorbed by the missing tooth were transmitted to the abutment teeth through the pontic connector and retainers. If exceeded beyond the physiologic limits of hard tissues, these forces can cause initial bone loss and failure of the prosthesis. Pier abutment, also named intermediate abutment, is defined by the Glossary of Prosthodontic Terms as a natural tooth between terminal abutments that support a fixed or removable dental prosthesis. This pier abutment acts as a fulcrum because of its strategic position when it is subjected to occlusal forces acting on the ends of the prostheses that will tend to lift the other end like a class I lever, causing stress on the terminal abutments and ultimately failure of the fixed dental prosthesis and trauma to the periodontium. Connectors are part of a fixed partial denture (FPD) that unites the retainers and pontics. Connectors may be rigid (solder joints or cast connectors) or non-rigid (precision attachment or stress breaker). Rigid connectors between retainers and pontics are the preferred way of fabricating most FPDs. Indications for non-rigid connectors are as follows:

- The presence of pier abutments, which encourage a scenario akin to a fulcrum that may lead to the failure of the terminal abutments and the intrusion of pier abutments.
- The malaligned abutment's presence, where concurrent preparation can cause devitalization. Intracoronal attachments can be used as connectors to resolve this problem.
- Long-span FPDs that may distort due to porcelain pulling and shrinking on delicate portions of the framework will influence how well the prosthesis fits over the teeth.
- As the mandible rotates mediolaterally during its opening and closing strokes, a non-rigid connection is seen in the mandibular arch, FPD, which consists of both posterior and anterior segments.
- Differences in the abutments' ability to retain.

Selecting the right type of connector during treatment planning is an essential step for the success and failure of the prosthesis. An FPD requiring the restoration of two missing teeth and where an intermediate pier abutment is present with a single casting (rigid connectors) is not an ideal treatment. According to the literature, there are four different kinds of nonrigid connectors, including Tenon-Mortise type connectors, Cross-pin and Wing type connectors, Split type connectors, and Loop type connectors. The most popular form is the Tenon-Mortise type, where precise Mortise positioning is technique-sensitive since it must establish parallelism for the precise course of distal retainer removal. The success or failure of the restoration depends on choosing the proper type of connector. The stiff FPD design prevents the abutment from responding independently under vertical loading situations. The abutments can respond to vertical loads independently thanks to the nonrigid FPD design.
Researchers who used quasi-three-dimensional photo elastic stress evaluation concluded that the FPDs showed signs of stress and occlusal displacement under continuous loading. In a study conducted by Savion et al., in 2006 using a mathematical model, the author concluded that debonding might occur in the anterior abutment but not due to the FPD teetering adjacent to the pier abutment. Conventional rigid connectors are commonly used in fabricating fixed dental prostheses (FPDs) as they provide strength and stability while minimizing stress. However, this approach may only be suitable for some cases. It is crucial for any restoration, especially FPDs, to withstand constant functional and parafunctional forces. In the case of FPDs, the forces normally absorbed by the missing tooth are transmitted to the abutment teeth through the pontic connectors and retainers. If these forces exceed the physiological limits of the surrounding tissues, it can lead to bone loss and prosthesis failure. A pier abutment, positioned between terminal abutments, acts as a fulcrum and experiences stress due to occlusal forces, which can lead to failure of the dental prosthesis and trauma to the periodontium.

4. CONCLUSION

In cases requiring pier abutments, especially five-unit bridges, the stiff connectors are a less suitable plan of treatment due to issues including physiologic tooth movement, arch location of the abutments, and retentive ability of retainers. The rigid connection to two or more teeth creates enormous leverage forces, and broken stress measures act as "safety valves" to counteract these forces. The size, shape, and type of connectors play an important role in the future success of a FPD. The selection of a proper connector is an important step in the treatment planning of pier abutment. Non-rigid connectors transfer less stress to abutments, also allowing physiologic tooth movement. Thus, the design and passive fit of non-rigid connectors is significant to the success of a long-span fixed partial denture.

9. REFERENCES


5. AUTHORS CONTRIBUTION STATEMENT

Dr. Aditee Apte conceptualized and made the design and drafted the data for the study along with Dr. Rewa Kawade. Dr. Seema Sathe (Kambala) discussed the methodology, analyzed the data, and provided valuable inputs for designing the manuscript. All authors read and approved the final version of the manuscript.

6. ETHICAL STATEMENTS

Ethical Statement: Permission was obtained from our institution, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Wardha to conduct and publish the case study. The patient was explained the study's purposes, and informed written consent was received for conducting the procedure and publishing the study. Assurance about confidentiality was given to the patient. The case was conducted according to the guidelines of the Declaration of Helsinki for biomedical research involving human subjects.

7. ACKNOWLEDGEMENTS

Dr. Aditee Apte conceptualized and gathered the data about this work and drafted the manuscript. Dr. Seema Sathe (Kambala) analyzed these data, and necessary input was given to the design of the manuscript. Dr. Rewa Kawade and Dr. Vedant Pathak contributed to the writing of the manuscript. All authors discussed the methodology and conclusion and contributed to the final manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

