The modification of split pontic as non-rigid connector in the management of pier abutment

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ABSTRACT In long-span fixed partial denture restoration, especially when pier abutment is present, a non-rigid connector as a stress breaker is indicated. The Non-rigid connector is classified into a dovetail, loop connector, split pontic, cross-pin, and wing. Split pontic is an attachment placed entirely inside the pontic, particularly indicated in the tilted abutment case, to prevent the box preparation of distal pier abutment. This case report presents A pier abutment case treated with long span porcelain fused to the metal fixed movable bridge using dovetail shaped attachment, assembling the split pontic as a non-rigid connector. Split pontic acts as the stress breaker to prevent the pier abutment acts as a fulcrum. Split pontic also transfers the shear stress to the alveolar bone, minimalizes the mesiodistal torquing of the abutment teeth, and enables individual tooth movement. The advantages of this design are preparation with minimal reduction and better esthetic outcome as the porcelain build up can be done. Thus, there is no metal exposure of the restoration. Longevity and success of fixed partial denture restoration depend on the size, shape, type, and connector position. In pier abutment cases, a non-rigid connector must be considered one of the treatment choices to restore the missing teeth and preserve the abutments.

KEYWORDS: pier abutment, split pontic, non-rigid connector

INTRODUCTION

Partial edentulous due to caries, trauma, or periodontal problems is common in dental treatment. In restoring missing teeth with a fixed partial denture, we as clinicians must consider aesthetic, biological, and mechanical aspects to ensure the restoration's longevity.1 One of the components part of a fixed partial denture is the connector. The rigid connector is the type of connector that is commonly used in most fixed partial dentures. It can provide desirable strength and stability and also minimize the stresses associated with the prosthesis. However, in the long-span bridge, a rigid connector is not indicated when pier abutment is present.1,2 According to the Glossary of Prosthodontic Term 9, pier abutment or intermediate abutment defines as a 'natural tooth or implant abutment that is located between terminal abutments that serve to support a fixed or removable dental prosthesis.3

In the Pier abutment case, teeth in different segments of the arch move in different directions. Because of the arch's curvature, an anterior tooth's faciolingual movement occurs at a considerable angle to the molar segment's faciolingual movement.2,4 These measurable magnitude movements and divergent directions can create stresses in a long span prosthesis that will be transferred to the abutments. Therefore, if an occlusal load is applied to one of the terminal abutment, the Pier abutment will act as a fulcrum generating tensile force between the retainer and abutments teeth at the other end. The anterior or posterior abutment will experience extrusive forces during fulcrum action, and resultant tensile strength at the retainer to abutment interface and eventually the debonding of the prosthesis due to marginal leakage of the restoration and caries.5,6

Treatment choice in restoring pier abutment case is a dental implant or fixed movable bridge with a non-rigid connector using precision or semi-precision attachment.7 Fixed movable bridge with a
non-rigid connector will serve as a stress breaker between the retainer and pontic, preventing the stress transmission from the force applied to another prosthesis segment.\textsuperscript{2,6} Non-rigid connector is classified into a dovetail or key-keyway, loop connector, split pontic, cross-pin, and wing.\textsuperscript{8} The non-rigid connector mainly used is the T-shaped key placed at the pontic and dovetail keyway at the retainer tooth.\textsuperscript{2} This type of connector usually have metal exposure on the occlusal surface. It can impair the esthetic of the restoration. A split pontic is an attachment that is placed entirely inside the pontic. It is used in tilted abutment and pier abutment cases. The use of a conventional dovetail would necessitate the preparation of a very drastic box in the distal aspect of the pier abutment. \textsuperscript{8,9} This case report presents the treatment of pier abutment case with a fixed movable bridge using dovetail shaped attachment assembling split pontic as the non-rigid connector to overcome the mechanical factor in pier abutment case and to achieve maximal esthetic as there was no metal exposure of the connector.

CASE REPORT

A 46-year-old female patient came to the Department of Prosthodontics Universitas Sumatera Utara Dental Hospital with a chief complaint difficulty chewing due to several teeth loss. Anamnesis showed that the patient never used any denture before and want to replace the missing tooth with a fixed prosthesis. The patient also demonstrated an excellent medical history. The dental history of the patient revealed that she pulled out her teeth last year due to caries. Intraoral examination showed that 34, 36, and 36 had been lost (Figure 1).

Abutment tooth 35 has a distal-labial torsion position, and abutment tooth 37 had an amalgam filling with a mesially tilted position. The occlusal scheme of this patient is group function (Figure 2).

Radiographic examination showed that all the abutment teeth have an excellent crown to root ratio, good periodontal tissue, and no pathologic lesion..

Figure 1. Intraoral Figure

Figure 2. The left occlusal scheme at the maximal intercuspation position (left) and lateral excursion (right)
The treatment choice that we offered to the patient is a dental implant or fixed movable bridge with a non-rigid connector. After discussion with the patient, she opted to restore her missing teeth with porcelain fused to metal fixed movable bridge with a non-rigid connector because she refused to undergo any surgery and economic problem.

Clinical procedure:
Abutment teeth 33, 35 and 37 prepared according to the preparation of metal porcelain requirement abutment of teeth with shoulder and equal gingival level marginal preparation (Figure 3)

Gingival retraction was performed, and the impression was taken with a modified two-step impression technique using putty and wash impression material (I-Sil Premium Putty dan light Body, Spident Co. Ltd, Korea) (Figure 4)

Impression poured by dental stone type V to obtain master cast. The master cast scanned using a 3D scanner and CAD/CAM-designed wax pattern (Figure 5). Bridge design consists of two-part. The anterior part is for 33,34 and 35. The male component is attached at the distal portion of 35 to form a pontic of 36 teeth. The posterior part consists of 37, and the female component that will unite with the male component assembling the split pontic of 36 tooth. It will acts as a non-rigid connector, becoming the stress breaker.

After the design, the wax pattern was milled and casted to achieve the metal. Then, we assessed the fitting at the master cast. (Figure 6)
Figure 5. Designing the bridge component with CAD/CAM.
A. Buccal view B. Occlusal view

Figure 6. Metal Framework.
A. Occlusal View B. Buccal View

Try in the metal to evaluate the marginal adaptation, fitting of the prosthesis to abutment teeth, and ensuring enough space for porcelain layering and the fitting and adaptation of male and female components (Figure 7).

Figure 7. Metal Try in A, B. Occlusal view C, D. Buccal view E. Antagonist tooth contact F. Lingual view
After try-in, the porcelain layering procedure was done. The fixed movable bridge was tried in the patient's mouth. Occlusion was checked. Then it was cemented with Luting cement (Fuji 1 Luting & Lining cement, GC Corp., Jepang). (Figure 8)

Figure 8. Cementation of a fixed movable bridge.

A Fixed movable bridge with a non-rigid connector. B, C. Occlusal view D. Cementation of the anterior segment of the fixed movable bridge from occlusal view E. Contact with antagonist teeth F. Lingual view

Post cementation instructions given to the patient include oral hygiene instruction using dental floss and interdental brush.

Follow up was done after one week of cementation. There was no complaint from the patient, and no inflammation sign of the abutment was detected.

DISCUSSION

Fixed partial denture using a dental bridge must be considered one of the standard treatment choices beside dental implants. The success of fixed partial denture about 87% for ten years and 69% for 15 years. The predisposition factor of the failure is the anterior non-vital tooth and pier abutment. Therefore, in these clinical situations, dental implant can be an alternative treatment in patients with good medical history, adequate bone support, and can afford it financially. Success or failure fixed partial denture depends on the design of every component of prostheses. The size, shape, type, and position of the connector can determine the restoration's success. Connector size must be adequate to prevent distortion and fracture of the repair but if the size is too big or bulky, it can compromise the oral hygiene and periodontal health.

The type of connector depends on the clinical situation. Several factors in designing fixed partial denture are torqueing, flexure, leverage dan peri cemental area that will ensure the success and adequate stress distribution along the tooth axis. Oruc S et al. reported stress concentrates at the retainer tooth’s connector and cervical area, including the pier abutment. In the Pier abutment case, teeth in different segments of the arch move in different directions. Because of the arch's curvature, the anterior tooth's faciolingual movement occurs at a considerable angle to the faciolingual movement of the molar tooth. These movements can create stresses on the abutments in the long-span prosthesis. Non-rigid connectors can be one of the alternatives to eliminate the pier abutment as a fulcrum line. The non-rigid connector will transfer the shear stress to the supporting bone tissue than concentrating it on the connector. It will be minimalizing the mesiodistal torquing of the abutment and enabling individual tooth movement. Separation of the long-span fixed prosthesis into a shorter part will be enabling individual replacement/repairment. Botelho and Dyson...
reported the usage of a rigid connector in pier abutment case to have a higher debonding rate than in short span case.\(^4\)

Moulding et al.\(^5\) performed a photoelastic stress analysis of supporting alveolar bone as modified by non-rigid connectors. He reported that the stress fields change depending on the location of non-rigid connectors. When a non-rigid connector is placed at the distal part of the pier abutment, the stress concentration in pier abutment is reduced. There were no stress concentrations at the anterior abutment with posterior loading in this design and vice versa. Markley (1951) recommended placing a non-rigid connector at one of the terminal retainers, while Gill (1952) recommended placing non-rigid connector at one side or both sides of the pier abutment.\(^5\) Schillingburg et al.\(^2\) suggested the placement of the non-rigid connector at the pier abutment because if it places at the terminal abutment, it will cause the pontic to serve as a fulcrum. Therefore, he recommended putting the male component of the non-rigid connector at the distal part of the pier abutment and the female role to be placed at the pontic's distal.\(^4,6\)

In this case, we use a modified split pontic with attachment placed entirely inside the pontic. The dovetail-shaped male component is placed at the distal part of the pier abutment and the female component covers the entire male component assembling the pontic. This design has several advantages such as conventional tooth preparation with minimal tooth reduction for the tilted tooth and better esthetic as the porcelain build-up can be done, so there is no metal exposure of the non-rigid connector. The disadvantages are technique sensitive and consuming more time and cost.\(^6\)

**CONCLUSION**

Every part and component of the fixed partial denture must carefully plan to ensure the restoration's longevity. The non-rigid connector usage as stress breakers in the pier abutment case must be considered to preserve the long-span fixed prostheses' stability and success.

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