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Digitally Printed Attachments- A Technique to Rehabilitate Pier Abutment Cases

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Abstract

Pier abutment is also known as an intermediate abutment is defined as a natural tooth located between terminal abutments that serve to support a fixed or removable dental prosthesis. The pattern of missing teeth may be in such a manner that a fixed prosthesis needs to be fabricated over a pier abutment. Mostly the first premolar and first molar are missing making the canine and second molar as terminal abutments and the second premolar, the pier abutment. A conventional FPD with a rigid connector will cause forces on the pier abutment making it to act as a fulcrum. These forces will be transmitted to the abutments on either side causing the prosthesis to fail. Therefore, the use of non-rigid connectors will help in transmitting the forces to the underlying bone and hence preserve the abutments. This case report provides a simple and cost-effective method to rehabilitate patients with pier abutments using customized attachments by digitally printing them.

Keywords: pier abutment, non-rigid connectors, semi-precision attachments, digital printing

Introduction

Fixed partial dentures (FPD) have been the most preferred treatment option for missing teeth. The proper selection of the abutments, type of pontic, retainer and connector will determine the success of the FPD. Occlusal forces generated during mastication are transferred to the abutment teeth via the various components of FPD. There is an accumulation of stresses within the FPD, especially at the connectors [1]. Hence, the selection of the type of connector is very critical.

In a clinical situation, where a pier abutment is present with edentulous spaces on either side of a lone standing abutment if a rigid connector is given forces will be

transmitted on the terminal abutments, while the pier abutment will act as a fulcrum [2]. Due to this, there can be debonding of the prosthesis leading to secondary caries or marginal leakage. In such situations, if a non-rigid connector is given, it will act as a stress breaker and prevent transmission of stresses to the abutments [3]. Non-rigid connectors act by allowing movement between the two parts of the FPD in a vertical plane, hence commonly used in long span bridges [4]. They are made of male and female component and are available as prefabricated ones or can be created in the wax pattern. Various authors have suggested different positions for the non-rigid connector.

This paper involves the fabrication of a long span FPD with a customized 3-D printed castable non-rigid connector.

Case Report

A 40 year old female reported to the Department of Prosthodontics with the chief complaint of difficulty in chewing and unaesthetic appearance while smiling. On intraoral examination, the maxillary left first premolar and molar were missing (Figure1). The radiograph showed adequate bone support of the abutments. Radiographic evaluation showed that implants could not be placed due to proximity to floor of maxillary sinus, therefore FPD was chosen as the treatment option. A 5-unit Porcelain fused to metal with a non-rigid connector was planned. As the abutments were vital, intracoronal attachments would require endodontic treatment and greater loss of tooth structure while preparing, as the attachment is within the confines of the abutment tooth. Hence in order to preserve the tooth structure, extracoronal attachments were planned. Extracoronal attachments are known to have lesser precision as compared to their intracoronal counterparts. Therefore, the attachments were planned to be 3 D printed for better retention.

Figure 1: Pre-operative intraoral view

- Tooth preparation of the teeth 23, 25, 27 was performed following the principles of preparation.(Figure 2)

Figure 2: Tooth preparation done

- Putty wash (Dentsply Aquasil Soft Putty & Light Body Kit Addition Silicone, Mumbai, India) impression was made to obtain the working cast. The impression was poured using type-IV gypsum.(Figure 3)

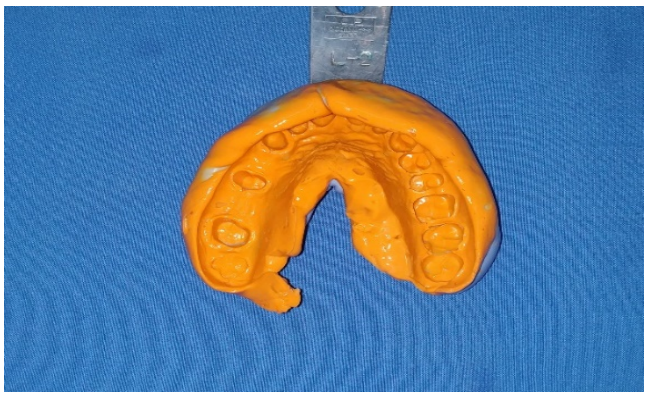

Figure 3: Definitive impression made

- Provisional restoration was cemented using a non-eugenol cement (Provicol, VOCO GmbH, Germany) (Figure 4).

Figure 4:Provisional restoration cemented

- Die pins were placed, die sectioning and articulation was done (Figure 5). Wax patterns(Uniwax, Delta, Bego) for metal copings were prepared for 23, 24 and 25.

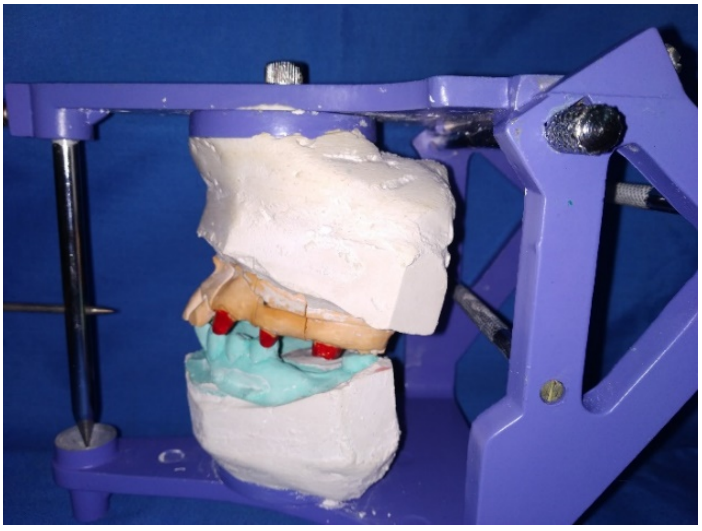

Figure 5: Articulation done

- Attachments for the non-rigid connector was customized using 3-D print software (Figure 6) and printed (W2P SolFlex 3-D printer, Vienna, Austria) using temperature resistant 3-D resin(SolFlex Cast Max wax, W2P, Vienna, Austria) (Figure 7)

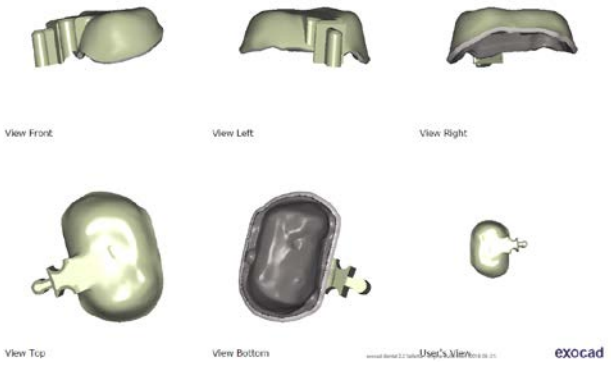

Figure 6: Designing of attachment

Figure 7: 3-D Printer and resin

- The Netfabb software(Asidek CT Solutions, Spain) was used for designing the attachment and then it was printed.
- The printed attachments were sectioned according to the dimensions of the prepared tooth.(Figure 8)

Figure 8: Printed attachment

- The key of the attachment was attached to the already fabricated wax pattern. (Figure 9)

Figure 9: Wax pattern with key of attachment

- The wax pattern was then invested and cast using cobalt-chromium alloy. (Figure 10)

Figure 10: Anterior metal coping

- The coping was placed on the cast and the castable keyway was positioned parallelly using a surveyor.
- The wax pattern for 26 and 27 (Figure 11) was completed, invested and cast.

Figure 11: Posterior wax pattern

- A metal trial of the copings was done to verify marginal fit and adequate clearance for ceramic build-up.(Figure 12)

Figure 12: Metal trial

- Following this, the ceramic build-up was completed.
- During cementation, the anterior segment was cemented first followed by the posterior segment using Glass ionomer cement (GC Gold Label luting cement, Telangana, India) (Figure 13).

Figure 13: Final Cementation

Discussion

The presence of a pier abutment creates a fulcrum like situation which causes the terminal abutments to fail due to a fulcrum like action. Studies suggest that when an FPD with pier abutment is made with a rigid connector have greater failure rates resulting from marginal leakage, debonding and secondary caries [5]. The terminal abutments may experience elongating/tensile stresses leading to loss of retention due to stress accumulation at the abutment-retainer interface [6]. In such a situation, a non-rigid connector is preferred as it acts as a stress breaker. Many authors have suggested different placement of their components. Markley suggested the placement of a non-rigid connector on terminal abutment [7]. Gill stated the placement on either side of the pier abutment [8]. It was Shillinburg who suggested the placement distal to the pier abutment as this will counteract the fulcrum like action and prevent unseating of the FPD from the terminal abutments [2]. A similar distal placement was suggested by Oruc et al [3].

Non-rigid connectors consist of a male and a female portion. They can be Intracoronal and extracoronal. In case of an intracoronal attachment excessive preparation of the pier abutment is required which may necessitate endodontic treatment of it. But if the pier abutment is vital, then an extracoronal attachment is preferable. Literature says that the precision in case of an extracoronal attachment is lesser as compared to intracoronal ones. Extracoronal attachments are conventionally fabricated by making wax patterns but this can cause poor retention between the anterior and posterior FPDs. In this case report we have used digitally printed attachments to improve the precision. The non-rigid connector was given distal to the pier abutment with the key in the distal aspect of it and the keyway in the pontic. The connector was designed digitally and 3-D printed. 3-D printing is a type of additive manufacturing technology to create an object by adding layers. Liquid photosensitive resins are cured by ultraviolet light source layer by layer to create a three- dimensional object. This is also known as Stereolithography[9]. Using this technique, it was possible to achieve a comparable precision in extracoronal attachment itself.

Conclusion

Non-rigid connectors are effective in reducing the concentration of stresses at the abutments in long-span FPDs and in pier abutment cases. Although it increases the number of laboratory steps, it prevents failures of the FPD by acting as a stress breaker. This is because they accommodate for the physiologic tooth movement thereby increasing the life of the prosthesis. Semi-precision attachments when designed digitally can provide retention comparable to that of Precision attachments. A proper selection of the type of connector is a very crucial step in the success of the fixed prosthesis.

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