ORIGINAL RESEARCH PAPER

Prosthodontics

A SIMPLE WAY TO FABRICATE A FIXED PROSTHESIS WITH A NON - RIGID CONNECTOR: A CASE REPORT

KEY WORDS: Non-rigid connectors, Pier abutment, Tenon-Mortise.

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ABSTRACT

This case report describes an innovative and cost effective way of fabricating a non-rigid connector (NRC) for a fixed dental prosthesis with a pier abutment. The occlusal forces applied to a fixed partial denture are transmitted to the supporting structures through the pontic, connectors and retainer. Rigid connectors between pontics and retainers are preferred for fabricating most fixed partial dentures, as they provide desirable strength and stability to the prosthesis. Fixed partial denture with all rigid connectors is less than an ideal treatment plan for a 5 unit fixed partial denture involving a pier abutment. As the pier abutment act as a fulcrum, abutment teeth move in divergent directions creating stresses and cause failure of the weaker retainer. Thus, the use of a non-rigid connector (NRC) in case of pier abutment is recommended. It transfers shear stresses to the supporting bone & permits abutments to move independently.

INTRODUCTION

In the scenario of replacement of missing teeth, fixed partial denture is always the treatment desired by every patient entering the dental office. The success of fixed partial denture (FPD) depends upon the selection of abutment teeth, retainer, connector, pontic design, and longevity of the edentulous span. Biomechanical factors such as overload, leverage, torque, and flexing can induce abnormal stress concentration and are detrimental to the FPD. Connectors, the portion of a fixed dental prosthesis that unites the retainer(s) and the pontic are considered important because under occlusal load, maximum stresses are concentrated on them.[1] Selection of the right type of connectors (rigid & non-rigid) can make a real difference between success and failure of a FPD and the real concern regarding connectors arises when we come across a case of 5-unit fixed dental prosthesis especially with a pier abutment. A common clinical situation that presents itself to a dentist is the missing first premolar and first molar in a maxillary or mandibular arch. So, for a FPD treatment plan in this situation, the canine and the second molar must act as terminal abutments while the lone standing second premolar with edentulous space on either side serves as the pier abutment.[2] And we, as dentists are more accustomed to using rigid connectors in FDPs. But in such a situation, the "Broken-stress" principle of stress breaking is advocated by means of an attachment (non-rigid connector). An attachment can be either a precision or semi-precision attachment.[3] Furthermore, the excessive flexing of a long-span FPD varies with the cube of the length of the edentulous span, which can lead to material failure of the prosthesis or an unfavourable response.[4] Thus non-rigid connectors become the solution. The movement in a non-rigid connector is adequate to avoid the conduction of stresses from segment being loaded to the remaining of the Fixed Partial Denture.[5] Also, a non-rigid fixed dental prosthesis appears to minimize mesiodistal torquing of the abutments while permitting them to move independently.[6]

CASE REPORT

A 45 years old female patient was referred to the Department of prosthodontics, with a chief complaint of difficulty in chewing and unpleasant esthetics. The intraoral examination revealed missing teeth - 14 and 16 (FDI tooth numbering system) {fig.1(a)}. IOPA radiograph showed good bone support for all the teeth (13,15 & 17) and hence they could be considered as prospective abutments for a teeth supported FPD. The treatment options presented to the Patient were:

a. Implant supported prosthesis in edentulous spaces.

b. Teeth supported fixed partial denture with non-rigid connector.

c. Removable type of partial denture.The patient did not agree for the implants due to surgical intervention and financial problem and was also not interested in a removable type of prosthesis. So, the treatment plan was to rehabilitate the edentulous area with a fixed partial denture with a non-rigid connector. In this case, a small plastic portion from a disposable flint lighter that resembled Tenon-Mortise was used to fabricate the non-rigid connector {fig. 2(a)}.

STEP BY STEP PROCEDURE:

- Teeth preparation was done for a metal ceramic restoration (fully veneered with porcelain) in 13 & 14 and buccal facing ceramic in 15,16 & 17 {fig.1(b)}.
- To accommodate the space for mortis, 0.75 to 1 mm of an additional preparation was done on the distal aspect of the pier abutment.
- The gingival retraction was carried out with gingival retraction cord (Knit TraxTM00, USA) and the final impression was made using addition silicone elastomeric impression (Neosilk, Korea) material with two step putty wash technique {fig.1©}.
- An interocclusal record was made using modelling wax (Hindustan, India).
- Provisional restoration was fabricated in relation to 13,14,15,16 & 17 (FDI tooth numbering system) with a tooth coloured auto polymerising acrylic resin (DPI, Mumbai, India) and cemented with non eugenol temporary cement.
- The impression was poured in type IV dental stone (Ultrarock, Kalabhai Karson Pvt. Ltd). After setting, the master cast was retrieved and die cutting was done {fig. 1(d)}.
- Then, the master cast was mounted on an articulator using the interocclusal record.
- The FPD was done as two segments – an anterior and a posterior segment.

- A wax pattern was fabricated for maxillary right canine, first premolar and second premolar and then a recess for the female portion was cut accordingly to fit the prefabricated plastic sleeve - female part (Anterior segment).

- Surveying was done to determine the position and parallelism of the plastic sleeve with that of the path of insertion of the distal abutment with the help of a Ney Surveyor (Dentsply, USA). During this step, the male part was kept inside the female part to accomplish parallelism {fig. 2(b)}.

- Female (Mortise) pattern was placed within the correct contour of the pier abutment. Any extension of the female pattern above the occlusal level of the abutment was left remaining {fig. 2©}.

- Male (Tenon) pattern was removed from the female pattern, keeping the inside of female pattern free of wax.

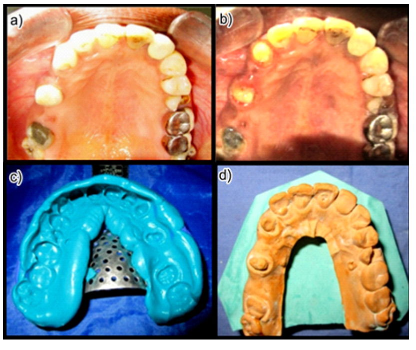


Fig. 1 (a) Maxillary arch, (b) Teeth preparation, (c) Master impression & (d) Master cast

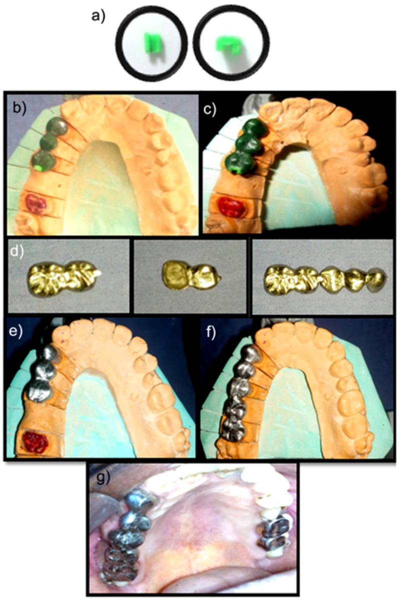


Fig. 2 (a) A small Portion from the disposable flint lighter used as the plastic pattern for the construction of non-rigid connector, (b) Wax pattern of the anterior segment with the male & female part analogue's (plastic pattern), (c) Wax pattern with female part within the contour of the retainer, (d) Metal framework (e) Casting of the anterior segment, (f) Casting completed, (g) Metal try in

- Then, the wax pattern of the anterior segment of the FPD was invested and casting was completed. After casting, excess height of the female part was cut down {fig. 2(e)}.

- The male pattern was seated in the cast female portion and then a wax pattern was fabricated for the right maxillary first molar and second molar and again the excess was left in place (posterior segment).

- Casting of the posterior segment of the wax pattern with the male part was carried out. After casting, the excess was removed and occlusion corrected with the help of an articulator {fig. 2(f)}.

- Metal try-in of the individual units was done to verify proper seating {fig. 2(g)}. Then ceramic layering (IvoclarVivadent) was completed [complete veneer for 13 & 14 and buccal facing for 15,16 & 17] {fig. 3(a) & 3(b)}.

- Anterior segment with the female portion and posterior segment with the male portion were assembled together.

Fig. 3 (a) Cementation of the mesial segment, (b) Cementation of the distal segment & (c) Verification of occlusion

- Bisque try in was done & Occlusion was checked {fig. 3©}. As the patient had group function occlusion before the start of the procedure, the same was established without non-working contacts.

- During cementation, first, the anterior three unit segment with keyway was cemented followed by cementation of the posterior two unit segment with key, using glass ionomer cement (Meron, VOCO, Germany)

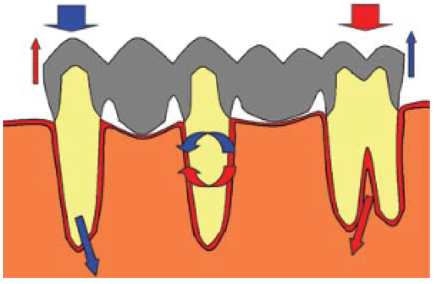
The patient was instructed to maintain proper oral hygiene. Use of dental floss and interdental brush were recommended. The patient was evaluated after one week to assess the oral hygiene status.

DISCUSSION

The FPD fabrication requires equal consideration to be given to the connector design. The size, shape, and position of the connector leads to the success of a prostheses, as it prevents the distortion and fracture of the prosthesis.[7] In this case, the patient was evaluated thoroughly and a comprehensive treatment plan was drawn. The possible treatment options with their pros and cons were discussed with the patient and finally it was decided to rehabilitate the patient with a non-rigid connected fixed dental prosthesis using the maxillary right canine and the second molar as terminal abutments and the second pre-molar as a pier abutment.

Rationale for using non-rigid connectors (NRC):

Restoration of 2 missing teeth and an intermediate pier abutment with a rigid FPD is not an ideal treatment. Three factors – physiologic tooth movement, arch position of the abutment and retentive capacity of retainers make this rigid five unit prosthesis a less than ideal plan of treatment.[8] When an occlusal load is applied to the retainer on the abutment tooth at one end of an FPD with a pier abutment, the pier abutment may act as a fulcrum. Also, during masticatory and parafunctional activity, the occlusal load on the pier abutment acts as a class I lever.[4] Thus, tensile forces may then be generated between the retainer and the abutment at the other end of the FPD.[1] Anterior or posterior abutments may experience extrusive forces during fulcrum action and resultant tensile force at the retainer to abutment interface may result in potential loss of retention for these restorations. Thus, these restorations may result in marginal leakage and caries. It has been reported that rigid FPDs with pier abutments are associated with higher debonding rates than short-span prostheses. Non-rigid connectors are suggested as a solution to these difficulties. A 50- to 100-g force may cause extrusion of abutments, depending on the location of the tooth in the dental arch.[9]



Schematic illustration of pier abutment acting as fulcrum (blue represents anterior loading, and red represents posterior loading situations).[9]

Torquing, flexure, leverage and peri-cemental area are the important factors which should be considered while designing a FPD for longevity and adequate distribution of stress along the long axis of the tooth.[3]

Many authors have reported that the stress fields change depending on the location of non-rigid connectors. The stress distributions of non-rigid connectors located at the distal of the canine and at the mesial of the molar were similar to the rigid design when all the teeth were loaded. But with the use of a non-rigid connector at the distal region of the pier abutment, the area of maximum concentration for the pier abutment was reduced. With this design type, there were no stress concentrations at the anterior abutment with posterior loading, and vice versa.[9] A controlled study showed that nearly 98% of the posterior teeth measured tilted mesially, when subjected to occlusal forces. If the keyway of the connector is placed on the distal side of the middle abutment, any mesial movement tends to seat the key into the keyway more solidly. Placement of the keyway on the mesial side, however, causes the keyway to be unseated during its mesial movements.[10] The various types of NRC used today are the Tenon-mortise, the cross pin and wing, loop and the split pontic. The most commonly used are the tenon-mortise or the key-keyway type. When a NRC was used in such a case, in spite of the seemingly close fit, it provided enough stress breaking so as to prevent the transfer of the forces from the segment being loaded to the rest of the FDP.[2] Use of pre-fabricated non-rigid connectors have an additional advantage over its semi-precision counterpart, as to being machine-made which would be more precise in function, stability and reliability.[3] Hence, a plastic part from the lighter was used here. The precision attachments were indicated in cases with compromised periodontal conditions to reduce the stresses on the abutment tooth. It was contraindicated in patients with abnormally high caries rate and where there was inadequate space. The semi-precision attachments were indicated in cases when patients could not afford for costly precision attachments.[11]

Disadvantages of non-rigid connectors are: (1) More tooth reduction in the pier abutment, (2) Increased laboratory time and expense. (3) In the absence of occlusal stability, key has been observed to lift away from their keyway.[2] Though there are some disadvantages with NRC, the advantages greatly outweigh the disadvantages.

CONCLUSION

Within the scope and limitation of this clinical report, it can be concluded that a fixed movable prosthesis is an ideal alternate choice to a cast partial denture in a partially edentulous situation where a pier abutment is located and that a custom made semi precision attachment can suffice the stress breaking effect necessary in a fixed movable prosthesis.[12] This case report describes an innovative and cost effective way of fabricating a NRC for a pier abutment. A small amount of time spent can make a big difference in the long run. So, the selection of the right type of connector is an important step in treatment planning.

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