

Non-rigid connectors in fixed prosthodontics: current concepts with a case report

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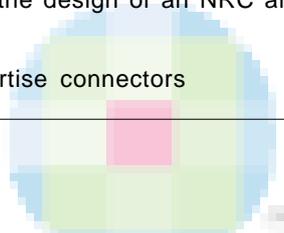
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The occlusal forces applied to a fixed partial denture (FPD) are transmitted to the supporting structures through the pontic, connectors, and retainers. Variables that may influence the longevity of an FPD and its abutment include occlusion, span length, bone loss, and quality of periodontium. The excessive flexing of the long-span FPD, which varies with the cube of the length of span, can lead to material failure of prosthesis or to an unfavorable response. Biomechanical factors such as overload, leverage, torque and flexing, induce abnormal stress concentration in an FPD. Stress concentration is found in the connectors of the prosthesis and in the cervical dentin area near the edentulous ridge. This factor plays an important role in the potential for failure in long-span FPD. The conventional use of a nonrigid connector (NRC) aids in compensating for the difference in the resistance and retention form between the abutments. The design and passive fit of NRC is critical to the success of a long-span FPD.

This paper presents the current concepts in the design of an NRC and a case report of Pier abutment treated with FPD having Tenon–Mortise Connector.

Key words: nonrigid connectors; Tenon–Mortise connectors



The occlusal forces applied to a fixed partial denture (FPD) are transmitted to the supporting structures through the pontic, connectors, and retainers.^[1]

Variables that may influence the longevity of an FPD and its abutment include occlusion, span length, bone loss, and quality of periodontium.^[1]

The excessive flexing of the long-span FPD, which varies with the cube of the length of span, can lead to material failure of prosthesis or to an unfavorable response.^[1]

Biomechanical factors such as overload, leverage, torque, and flexing induce abnormal stress concentration in an FPD.^[2]

Stress concentration is found in the *connectors* of the prosthesis and in the *cervical dentin area* near the edentulous ridge. This factor plays an important role in the potential for failure in long-span FPD.^[2]

Connectors are that portion of the FPDs that unites the retainers and the pontics. They are of two types, rigid connectors and nonrigid connectors (NRCs).^[2]

Rigid connector could be made by casting, soldering, and welding. The cast connectors are to be properly shaped in wax patterns. The soldered connectors are made by fusion of intermediate metal alloy to the

previously made castings.

The connector that permits limited movement between the otherwise, independent members of the FPDs is the *NRC*.

The NRC could be made by an incorporation of prefabricated inserts, by use of a custom-milling machine or by use of the prefabricated plastic patterns.^[3]

The custom-milling machine is a device used for working or forming materials into a desired form, to blend materials or to perform other mechanical properties. (Bachmann or *PFM 100*, Cendres and Metaux, SA, Canada) [Figure 1].

It has the following three functions

- First, as a surveyor to determine path of insertion.
- Second, to align attachments or other assemblies to an extremely high level of accuracy and
- Final in milling, a process of (giving desired shape) wax or metal in-line, angled or parallel shaping to given contours, depending upon the type of work, with the added advantage that it can be used for angled or parallel drilling.

The prefabricated inserts require a preparation of the box in the wax pattern. The plastic slot is incorporated

in the wax pattern with the help of the custom-milling machine or a dental surveyor. The custom-milling machine could also be used for a refinement of the casted slot.

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 prostheses, as it prevent the distortion and fracture of the prosthesis.

The connector should provide adequate access for

the maintenance of oral hygiene. It should avoid display of metal for achieving optimum esthetics. The connector should be curved facio-lingually. Mesio-distally, it should have a smooth transition and bucco-lingually, it must be elliptical.^{[1],[2]}

The NRC should be prepared within the contours of the retainers and the male (Tenon) is attached to the pontic [Figure 2]. The limiting factors are the abutments having a large pulp size, and abutments with reduced clinical crown height.

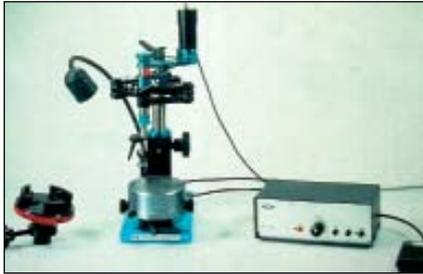


Figure 1: The custom-milling machine is a device used for working or forming materials into a desired form, to blend materials, or to perform other mechanical properties (Bachmann or PFM 100)

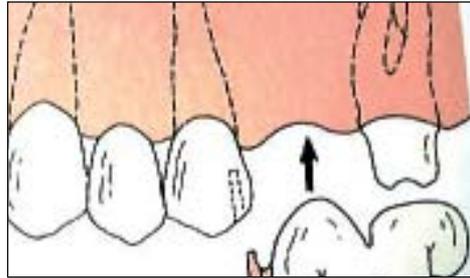


Figure 2: The NRC preparing within the contours of the retainers and the male (Tenon) is attached to the pontic



Figure 3: Oral examination revealing missing first premolar and molar. The second premolar had a fractured filling and the second molar was mesially migrated



Figure 4: The distal of the second premolar is preparing to accommodate a NRC



Figure 5: Single step putty-wash impression for preparation of the working model



Figure 6: After finishing of FPD, application of ceramic was done on the buccal surface



Figure 7: First the cementation of anterior segment was done and then the cementation of the posterior segment was done



The *indications* for the use of the NRC in fixed prosthodontics are as follows

1. The existence of *Pier abutment*, which promote a fulcrum-like-situation that can cause the weakest of the terminal abutments to fail and may cause intrusion of the pier abutment.
2. The existence of *malaligned abutment*, where parallel preparation might result in devitalisation. Such situations can be solved through the use of intracoronal attachments as connectors.
3. The presence of *mobile teeth*, which need to be splinted together with the fixed prosthesis. In such situations, it is not practical to cement a splinting type restoration with numerous teeth involved. Through the use of interlocks, smaller segments can be cemented with the splinting effect provided by the interlocks.
4. *Long span*, FPDs, which can distort due to shrinkage and pull of porcelain on thin sections of framework and thus, affect the fitting of the prosthesis on the teeth.
5. In situations where *questionable distal abutment* exist and fabrication of the removable partial denture is considered to be the next treatment step, the use of the NRC may solve the problem of repeating the restoration of the remaining abutments.
6. It could be also used in cases of osseointegrated implants.

The NRCs are mainly used to *relieve stress* on the abutment and to accommodate *malaligned* FPD abutments.

The four types of NRCs^{[3],[4]} are the

1. Dovetail (key-keyway) or (Tenon–Mortise) connectors.
2. Loop connectors.
3. Split connectors.
4. Cross pin and wing connectors.

Align the path of the keyway to that of distal abutment. Deep wax box is carved into distal of wax pattern for the incorporation of keyway, which in turn requires intracoronal preparation of adequate depth and parallel path of insertion.

Some nonadjustable intracoronal attachments

1. *Rod and tube attachment*: It could be used in FPDs with a minor alignment problem of the abutment.
2. *Cylindrical slide attachment*: Same as above.
3. *Stern tube-lock*: Patrix and matrix elements are plastic burnout patterns, which are incorporated into the wax patterns and cast.
4. *Preat-contur*: Slide attachment tapering from the occlusal surface to the cervical margin.
5. *Conicast*: Same as the Preat-contur.

6. *Dovetail slide attachment by Prof. Beyeler*: could be used in posterior FPD with minor alignment problem of the abutments and as a connector.
7. *Laboratory-made*: It appears simple but requires precision.

Adjustable intracoronal attachments

1. *Ancra*: Activation could be done by the expansion of the slot with a suitable instrument.
2. *McCollum*: The active side of the Patrix must face buccally to allow activation without interference from the lingual or palatal bracing support.

If a NRC is placed on the mesial side of the middle abutment, mesially directed movement will *unseat the key*.^[2]

If a NRC is placed on the distal side of the retainer of the middle abutment, movement in the mesial direction will *seat the key into the keyway*.

CASE REPORT

A 35-year-old lady came to our Department, with the chief complaints of replacement of some missing teeth in the upper left posterior region. She also gave the history of root canal treatment done in the upper left posterior teeth 1 month ago.

Period of edentulism was approximately 3 months. Oral examination revealed missing first premolar and molar. The second premolar had a fractured filling and the second molar was mesially migrated [Figure 3].

Radiologic examination revealed properly filled root canal, with good bone index of the abutments, without any periapical pathology.

Preparation of canine, second premolar and molar was done for metal-ceramic FPD with buccal ceramic facing and a NRC between the second premolar and first molar. The buccal margin was deep chamfer and all the other margins were chamfer finish line. The distal of the second premolar was prepared to accommodate a NRC [Figure 4].

Single step putty-wash impression was made for the preparation of the working model. It was poured in high strength die stone [Figure 5].

The provisionals prepared were cemented with temporary luting cement.

Fixed partial denture with NRC was prepared. First, the anterior segment of canine, first and second premolars with the keyway (Mortise) on its distal aspect was fabricated. Then the second and first molars with key (Tenon) on its mesial aspect was fabricated in wax and then cast.

After finishing of the FPD, application of ceramic

was done on the buccal surface [Figure 6].

First the cementation of anterior segment was done and then the cementation of the posterior segment was done [Figure 7].

CONCLUSION

Ideally, the long axes of abutments should be parallel to each other, but the preparation of FPD gets complicated by misaligned teeth and/or edentulous space. This could be avoided by the use of NRC.^{[1],[2]}

The *features* of NRCs are as follows: The component parts may not have a common path of placement. It is possible to do segmenting of long span FPDs, having shorter components. It may be incorporated in a situation wherein one of the abutments may have questionable prognosis. Also, the NRC could be incorporated into a FPD with the anterior and posterior segments.^[5]

The conventional use of a NRC aids in compensating for the difference in the resistance and retention form between the abutments. The design and passive fit of NRC is critical to the success of a long-span FPD.

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