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Review Article

Cantilevered Fixed Partial Denture

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Abstract

Introduction: Because of the growing requests by patients for a fixed prosthesis, to avoid the extensive surgical or restorative procedures that may be involved in an implant or teeth supported fixed prosthesis, many dentists have been using fixed partial dentures with free end pontics. Such prosthesis, called cantilever fixed partial dentures have one or more abutments at one end while the other end remains unsupported [1]. Much controversy surrounds cantilevered FPDs, but despite negative arguments, clinicians still extensively use them. If used non-judiciously, they can lead to complications. The prime disadvantage of cantilever FPDs is the creation of a class one lever. Forces that are transmitted through the unsupported pontics can cause tilting and rotational movements of the abutment, leading to its failure. The success of a cantilever FPD depends on various factors, including abutment selection, the strength of connectors and the control of functional forces. When planned correctly, cantilever prosthesis can be used as an alternative treatment modality.

Aim of the Study: The aim of this paper is to discuss the basic concepts of cantilever fixed partial dentures, the factors that play a role in its planning and success, and their clinical applications.

Methodology: The article is a comprehensive research of PUBMED papers.

Conclusion: When planned carefully and used judiciously, cantilevered fixed partial dentures serve as a good alternative treatment option. It is a compromise when compared to an FPD secured at both ends and an implant, but may serve the primary purpose of rehabilitation in cases where the other options are not feasible due to any reason. However, it requires thorough evaluation and treatment planning, taking biomechanical, stress distribution, and occlusal factors into consideration. Favorable clinical conditions, appropriate design, sound mechanical features and good post insertion hygiene are necessary for the longevity and success of such prosthesis.

Keywords: *Cantilever Fixed Partial Dentures; Free Pontics; Anterior Cantilever FPD; Cross Arch Cantilever FPD*

Introduction

Patients now days prefer having their teeth replaced with a fixed prosthesis instead of removable ones. These, however, may, at times, involve extensive surgical procedures or multiple endodontic procedures. In cases where the patient is reluctant or unable to undertake

these procedures due to any reason, an alternate treatment modality in the form of cantilever prosthesis exists. It is also preferred in the posterior region to avoid removable prosthesis. A cantilever fixed partial denture is prosthesis with one or more abutments at one end and unsupported at the other end [1].

The free pontic in a cantilever FPD results in the creation of a class one lever system, the prime disadvantage of such a prosthesis. When the cantilevered pontic is subjected to occlusion stress, forces are transmitted to the abutment teeth. These forces are greater than the applied stress [2]. A high incidence of failure and damage has been reported with such restorations, making many dentists reluctant to prescribe them. It is of paramount importance to understand and take into consideration the biological and mechanical factors and stress distribution while planning such FPDs. The success of a cantilever FPD depends on favorable clinic conditions, sound mechanical features, appropriate design of the free pontic and maintenance of the supporting periodontium [3].

If used judiciously and planned carefully, cantilever FPDs can be a valuable service.

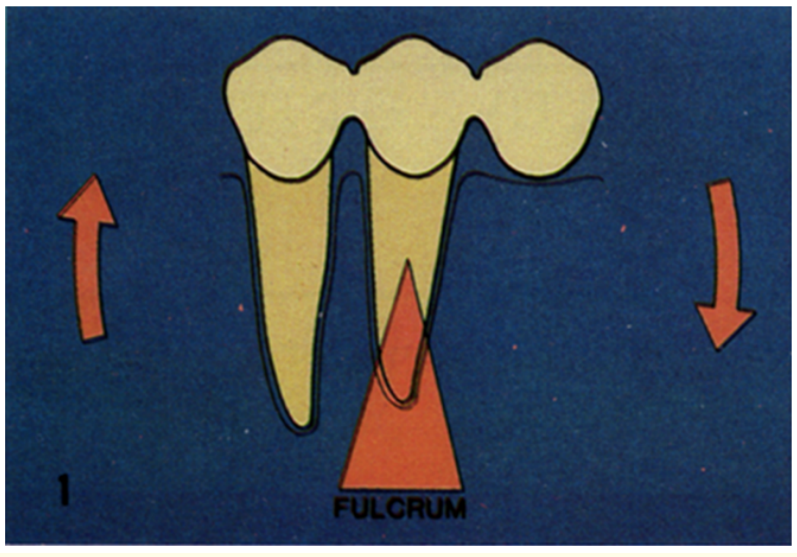

Figure 1: *Creation of a class 1 lever by a cantilvered FPD [3].*

Planning a cantilever fixed partial denture

Planning a cantilever fixed partial denture is of principal importance to ensure its longevity. It is important to understand and correlate three main factors to plan a cantilever FPD [4]:

1. Forces and stress distribution
2. Role of occlusion
3. Biomechanical considerations.

Forces and stress distribution

It has been observed that compared to an axial load, a nonaxial force applied on a single tooth elevated forces in the periodontium more. The forces are increased as the loading on the tooth becomes more oblique [5]. If the load is directed to the free end of the cantilever, forces are more on the periodontal membrane of a single tooth as compared to that of two splinted abutment teeth. Such splinted abutment teeth also resisted rotational movements [5].

It has also been found that the abutment nearest to the cantilever pontic absorbed 50% of the load and adding another abutment tooth lessened this force [2]. In cross arch unilateral cantilever FPD, it was observed that the cantilevered pontic was subjected to fewer forces as compared to the contralateral posterior abutment during light tapping, chewing, swallowing and biting [6].

The muscles of mastication apply the highest amount of forces in the posterior part of the arch. Therefore, if a cantilevered FPD is placed in the posterior region of the arch, additional abutments are recommended to withstand the forces (Figure 2) [1].

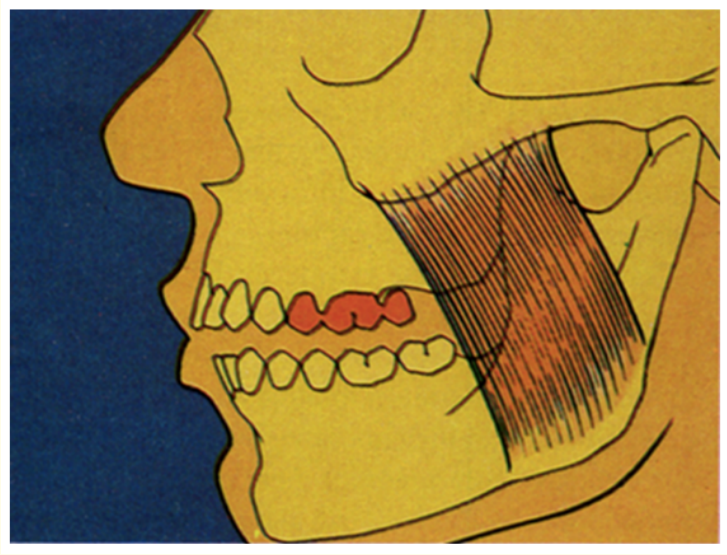

Figure 2: *Cantilevered FPDs in the posterior region are subjected to more forces [1].*

Role of occlusion

Some authors have suggested that cantilevered FPDs were more often indicated in situations where there was reduced stress, such as opposing a completed denture [9]. Others, however, have reported no significant clinical correlation between technical failures of cantilever FPDs and the type of opposing dentition. They argued that a well-supported, steady complete denture would also produce high functional loading [10].

Periodontally compromised teeth can be used as an abutment for cantilevered FPDs. Stable FPDs were found to be successful despite individual mobile abutment teeth. Prolonged stability was achieved by periodontal therapy and the development of a stable occlusion. To prevent migration, tilting and increasing mobility, balancing contacts were established [7].

In periodontally compromised teeth in dentitions with cross-arch unilateral posterior two-unit cantilever FPDs, the masticatory forces are decreased. The side with the cantilever is never selected as the favored chewing side. Therefore, if the occlusion is found to be stable and the cantilever is free from premature contacts, the cantilever would only be subjected to sizeable forces unintentionally [8].

It has been suggested that it is preferable to transfer the load from the cantilever to the abutment by ascertaining the pontic as an occlusal stop. It is advised that the buccolingual width of the pontic should not be broader than the width of the nearest retainer (Figure 3) [1].

Figure 3: *Buccolingual width of the pontic is designed to be narrower than the retainer to control occlusal forces [1].*

Biomechanical consideration

The abutment adjacent to the pontic should have good periodontal support as maximum functional stress is transferred to this tooth. The abutment farthest should be extremely retentive so as to resist dislodging forces [9].

A cantilevered FPD should have at least two abutments and not replace more than one tooth [1]. In the case of a posteriorly placed pontic, additional abutments should be included to withstand the strong forces from the masticatory muscles.

If all stresses are actively concentrated on the distal cantilever, the local force was 150N, but this is unlikely to occur in natural function unless the pontic is subjected to premature contacts of non-clinical size [8].

A review found that the greatest strain on a cantilevered FPD occurs mesial to the most distal retainer. Most restorative fractures occur at this point. The distal retainer should, therefore, preferably be designed as a complete crown with near parallel walls of the tooth preparation to ensure sufficient retention [11].

Vital teeth are preferred over endodontically treated teeth as abutments. Vital teeth with optimal bone support have better mechanoreceptor feedback control by the periodontium than non-vital teeth on bending and loading, making them less susceptible to root fractures that are frequent in non-vital cantilever abutments [12].

Requisites for a successful cantilever fixed partial denture

Four Main criteria have been identified to endure the success of a cantilever FPD [3].

Favorable clinical conditions

Many failures with the cantilever FPD are associated with the hasty assessment of the clinical conditions without substantial data. It is of utmost importance to conduct a thorough clinical examination before planning such prosthesis. This includes a detailed medical and dental history, extraoral and intraoral exams, complete mouth radiographs and evaluation of articulated diagnostic casts [13].

Good oral hygiene is of paramount importance for the success of any prosthesis. Definitive treatment should be deferred until the patient is willing to or able to maintain good plaque control. Abutment teeth should also be accessed before planning a cantilevered FPD. Non-vital teeth are not preferred as abutments because they have an increased susceptibility to root fractures in cantilevered FPDs [12]. The abutment teeth should also have sufficient crown length and favorable root morphology [14].

A mucosa borne prosthesis, such as a denture, is the ideal opposing occlusion for a cantilevered FPD because they exert limited forces on the free pontic. Patients with excessive or premature wear patterns or parafunctional habits are not ideal patients for cantilever prosthesis [1].

Sound mechanical features

The abutment teeth in cantilever prosthesis resist forces by rotational and tilting movements rather than axial movements. It is of utmost importance to understand the nature of each component of the prosthesis to prevent damage to the periodontium and failure of the prosthesis [2].

A cantilevered FPD should have at least two abutments and not replace more than one tooth [1]. In the case of a posteriorly placed pontic, additional abutments should be included to withstand the strong forces from the masticatory muscles.

The greatest strain on a cantilevered FPD occurs mesial to the most distal retainer. Most restorative fractures occur at this point. The distal retainer should, therefore, preferably be designed as a complete crown. Secondary retention grooves and box preparations may be used when necessary [11].

Connectors should have a U-shaped rather than a sharp V-shaped outline form to help reduce and distribute stress. They should also be of sufficient thickness to avoid deformation or fracture under stress (Figure 2) [1].

Appropriate design of cantilevered pontic

Mucosal irritation is consistently associated with FPD pontics. This response may be more pronounced with the cantilevered pontic as it is supported at only one end. This increases the possibility of movement of the pontic and subsequent mucosal trauma during the function [15].

If the pontic has a glazed or polished surface, tissue response depends more on the design of the pontic and on the oral hygiene of the patient than on the material from which it is made [16]. Nevertheless, the tissue surface of the pontic should be designed to provide select mucosal contact, enabling minimum pressure between the pontic and the mucosa. The pontic should be designed to provide adequate cheek and tongue support, access for plaque control, and acceptable aesthetics (Figure 4) [1].

Figure 4: *Pontics should be designed to fulfill the patients physiological, functional and esthetic needs.*

Occlusal forces should be directed to the abutment teeth so as to give the free pontic just a centric occlusal stop and avoid a discoursal function. It is advised that the buccolingual width of the pontic should not be broader than the width of the nearest retainer crown (Figure 3) [1].

Maintenance of supporting periodontium

Treatment is not finished with the cementation of the restoration. Occlusal adjustments should be made and adequate oral hygiene must be maintained. The patient must be educated and instructed on the appropriate methods of plaque control, and regular follow-ups must be done to reinforce them to ensure an ideal tissue response. The success of the prosthesis is impossible without the complete co-operation of the patient [1].

The following factors have been suggested by Ewing when making a physiological appraisal while planning the cantilever principle:

1. Good periodontal attachment,
2. Adequate alveolar support,
3. Favorable root length, shape and crown length,
4. Favorable arch-to-arch relationship,
5. Favorable tooth-to-tooth relationship [14].

Clinical applications

Properly planned cantilever FPDs with adequate periodontal support have universal application. Special emphasis is on cantilever FPDs as an alternative to RPDs. Resorption of the anterior alveolar ridge is a common complication of the mandibular RPD [9].

In a study, patients treated with complete maxillary dentures and mandibular distal extension cantilever FPDs were periodically assessed. All patients expressed significant improvement in mastication and stability of the maxillary denture, even those who previously had RPDs. After two years, all FPDs where intact and the abutments were symptom-free [17].

Another similar study compared patients that had mandibular distal extension cantilever FPDs and patients with mandibular RPDs. The cantilever FPD group showed significantly fewer symptoms of mandibular dysfunction during a 2-year time. Occlusion also appeared to be satisfactory in more patients from the Cantilevered FPD group. Less post insertion adjustments and treatments were required in the cantilever FPD group [17].

It is recommended to have at least two abutment teeth for cantilever FPDs. The only exception is the replacement of a maxillary lateral incisor with a canine as the abutment. Cantilevered fixed partial dentures have the potential to be more successful in the anterior region than posterior because of the fewer forces [9].

Anterior cantilever fixed partial dentures

Replacement of a missing maxillary lateral incisor with the canine as an abutment is the only documented exception to the two-abutment rule. This is the ideal indication for cantilever FPD. However, a mesial rest on the central incisor is recommended to avoid movement of the canine. These restorations are considered when the central incisor is intact, and when an implant isn't possible (Figure 5) [9].

Figure 5: *Maxillary lateral incisor replaced with a cantilever FPD.*

Anterior cantilevers FPDs are indicated in open bite cases and cases with normal vertical and horizontal overlap. They are not indicated in cases with excessive vertical overlap and cases with class 3 malocclusion [18].

Posterior cantilever fixed partial denture

Premolars may be replaced by cantilevered FPDs where there is a desire to avoid the involvement of a canine or a preexisting fixed prosthesis. However, either two abutments or splinted teeth are suggested [9]. A cantilevered FPD may be used in the posterior region to

replace missing molars and avoid a removable prosthesis. Although it does not appear to improve masticatory function, it does prevent supra eruption of an opposing tooth and provides stability to an opposing removable denture [4].

Conclusion

When planned carefully and used judiciously, cantilevered fixed partial dentures serve as a good alternative treatment option. It is a compromise when compared to an FPD secured at both ends and an implant, but may serve the primary purpose of rehabilitation in cases where the other options are not feasible due to any reason. However, it requires thorough evaluation and treatment planning, taking biomechanical, stress distribution, and occlusal factors into consideration. Favorable clinical conditions, appropriate design, sound mechanical features, and good post insertion hygiene are necessary for the longevity and success of such prosthesis.

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