

Endodontically Treated Teeth in FPD

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Abstract

Introduction: A fixed partial denture [FPD] aims at replacing a missing tooth with the help of adjacent teeth and can be long span, short span, or cantilever. For a very long period of time, FPDs were considered as the only and the most successful option for the replacement of missing teeth. Compromised or missing teeth can be restored to their full function, masticatory abilities, and esthetics while taking into consideration the dental arch health and integrity with the help of good endodontic treatment and prosthesis. Endodontically treated teeth [ETT] can be used as an abutment for a fixed partial denture, and in that case, the restoration of ETT becomes even more difficult, as it has to be used for long-span dentures, which tend to put more pressure on the tooth than when compared to a single crown. A tooth that is used as abutments has to withstand the forces applied on the missing teeth, which are transmitted towards them with the help of connectors and also the ones directed towards the abutment teeth itself.

Aim of Work: This review aims at highlighting the use of Endodontically treated teeth as an abutment for Fixed Partial Denture and ways to reinforce the same for increased efficiency.

Methodology: The review is a comprehensive research of PUBMED and Google Scholar from the year 1985 to 2019.

Conclusion: Endodontically treated teeth, when used as abutments in fixed partial dentures, have to bear more load as compared to those with single crowns. When a fixed partial denture is planned for a patient, the quality of endodontic treatment done should not be ignored, the amount of bone support, quality of root canal treatment done, crown root ratio of the abutment teeth, tilt of the tooth, all these should be taken into account. Post endodontic restoration of teeth should always be done, taking into account the amount of tooth structure remaining, the kind of function the tooth has to perform after restoration. Fiber-reinforced composite posts tend to increase the strength of ETT and can be used in case the tooth has to be used as an abutment in FPDs.

Keywords: Endodontically Treated Teeth; Abutments; Fixed Partial Denture; Ferrule; Fiber-Reinforced Post; Ante's Law

Introduction

Reconstructive dentistry means the entire reconstruction of a compromised tooth, and it always poses a challenge due to limited hard tissue remaining for retention [1]. A huge number of patients come to the clinic with the chief complaint of the replacement of a missing tooth. A fixed partial denture [FPD] aims at replacing a missing tooth with the help of adjacent teeth and can be long span, short span, or cantilever. For a very long period of time, FPDs were considered as the only and the most successful option for the replacement of missing teeth. Compromised or missing teeth can be restored to their full function, masticatory abilities, and esthetics while taking into consideration the dental arch health and integrity with the help of good endodontic treatment and prosthesis. Before the advent of adhesive restorations, it was thought that full coverage restoration or complete removal of compromised teeth was the only option for restoration of compromised teeth, which was endodontically treated. There are various ways in which the endodontically treated teeth can be restored. According to the amount of tooth structure remaining, post endodontic restoration can be decided which can be either a composite resin restoration, fiber-reinforced composite post with a resin core [2].

Endodontically treated teeth [ETT] can be used as an abutment for a fixed partial denture, and in that case, the restoration of ETT becomes even more difficult, as it has to be used for long-span dentures, which tend to put more pressure on the tooth than when compared to a single crown. A tooth that is used as abutments has to withstand the forces applied on the missing teeth, which is transmitted towards them with the help of connectors and also the ones directed towards the abutment teeth itself. The kind of connectors used, which are either a rigid or non-rigid connector, also affect the force applied on the ETT [3].

In a study conducted by Sorenson *et al.* [4], It was concluded that the success rate of ETT, when used as an abutment, was less when compared to single crowns. In another review done by Goga., *et al.* [5], they concluded that ETT, whenever used as an abutment, should be taken extra care of as their lives get shortened when used with a long or short span FPD. In teeth, where there is an extensive loss in tooth structure, sometimes during restoration, a post can be placed, which dissipates the force applied on the tooth and increases the strength of the tooth [6].

Placement of posts in the root canal helps in the retention of the core build-up material and increases the overall strength of the tooth as compared to a plain core build-up. Teeth used as abutments are often subjected to very high horizontal and torqueing forces when used in fixed partial dentures and are at a higher risk of fracture. Some studies have mentioned contradictory results stating that the placement of posts in ETT when used for abutments in the crown can reduce the fracture strength of the tooth. A general agreement has still not been reached. In this review, we aim to discuss elaborately the different factors taken into consideration while choosing an abutment tooth, different indication, and contraindication of using endodontically treated teeth as abutment teeth [7].

Factors affecting abutments

Diagnostic casts

The Diagnostic casts play an important role as they replicate the occlusion of the patient and should always be oriented such that the plane of occlusion and eccentric movements can simulate one that is present in the mouth. The alignment of the abutment teeth and teeth in opposing arches can also be observed in the cast [8].

Radiographic evaluation

A thorough radiographic evaluation is very important before selecting the abutment teeth as they help in the evaluation of the pulpal status of the tooth, presence of any proximal caries which otherwise hidden in clinical evaluation, the anatomy of the root, any periapical lesion, any periodontal defect like loss of bone or intrabody defects [8].

Surface area of the periodontium

In 1926, Ante came up with Ante’s law, which states that the combined pericentral area of the teeth used as abutment should be either equal to or greater than the teeth that need to be replaced [8]. In cases where Ante’s law is not followed, multiple abutment teeth can be selected, and the mesiodistal width of cusps of abutment teeth should be more than the width of the cusp of points (Figure 1). Teeth, which are big in overall dimensions, are preferred as abutment teeth as they have a larger surface area [8].

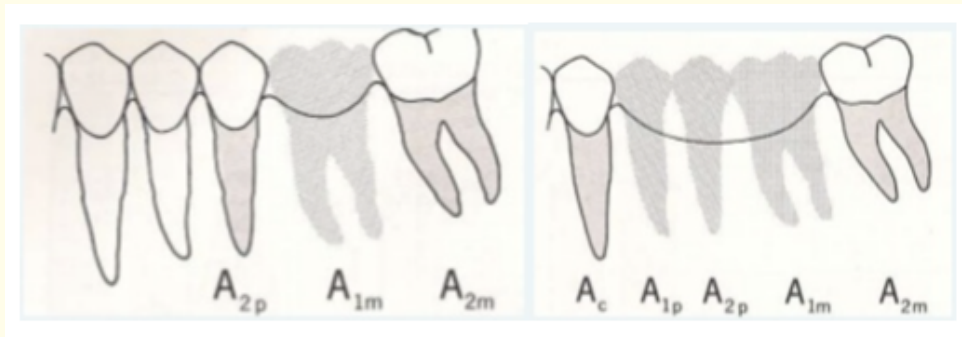


Figure 1: Ante’s Law; a) FPD satisfying Ante’s Law b) FPD not satisfying Ante’s Law [8].

The ratio of crown to root

Crown Root ratio signifies the relationship of the length of the tooth above the alveolar bone to that below the alveolar bone. As the tooth length increases above the bone or the bone moves apically, the grip of the tooth becomes loose, and mobility increases, thereby reducing the chances of the tooth to be used as an abutment as lateral forces increase on the tooth. The ideal Crown Root Ratio that can be used for FPD is 1:2 as given in textbooks, but in clinical scenarios, a ratio of 2:3 is used most often. The minimum crown to root ratio that can be used is 1:1. (Figure 2) However, in a study conducted by Dykema., *et al.*, [9], a ratio of 1:1.5 is considered acceptable if the status of the periodontium is healthy and occlusion is under control. In case the crown to root ratio is not acceptable, the abutments can be increased in number [10].



Figure 2: A) And B) Crown Root Ratio Not Acceptable V) Acceptable Crown Root Ratio [11].

Form of the arch

The movement of teeth is different in different areas of the dental arch. Movement of anterior teeth in the faciolingual direction is different compared to that of the posterior teeth because of the curvature of the teeth. Because of the forces applied on the teeth, rotation is seen in the abutment teeth, and vertical force is applied on the ends of the FPD. Replacing the upper incisors in a narrow arch is the most difficult. The lever arm will be shortened in the case of a small incisor and can be overcome by increasing the number of abutments. In case there is a canine fixed partial denture, premolars can be used to increase the retention of the denture [12].

Anatomy of the tooth

Anatomy of the tooth greatly affects the transmission of the load. Because of the sharp ridges and grooves present on the occlusal surface of the tooth, the cutting action increases, thereby reducing the amount of load transmitted due to decreased contact area. In a study conducted by Stallard, he pointed out that attrited teeth increase the amount of masticatory force applied on the tooth surface, and more strength is required from the masticatory muscles [13].

Configuration of the root

The length of roots is an important factor while delivering strength to the abutments; longer roots tender more strength as compared to short conical roots and hence is used for longer span FPDs. multirooted teeth are always more preferred than single conical roots [14].

Length and tilt of the crown

The height of the pontic is a major factor while choosing the abutments; increasing the height of the pontic requires more than one abutment tooth. In case the crown length of abutment teeth is less than 4mm, multiple teeth should be splinted together and used as an abutment [14].

Restoration of endodontically treated teeth to be used as an abutment

The success of endodontic treatment depends not only on the quality of root canal treatment done but also the post endodontic restoration is given to the tooth, which seals the canal and prevents leakage of oral fluids in the canal and periapical area by the placement of the coronal restoration. The amount of tooth structure remaining indicates whether a post has to be used or not. A lot of research has gone into deciding the best form of post according to the shape, length, and thickness of posts. The advent of adhesive restoration further increased the indication and usage of posts as it increased the strength of the tooth. Sedgley, *et al.* stated that the brittleness of vital teeth is less than non-vital teeth as dentin is harder in vital teeth. Achieving a pulpal access generally reduces the stability of the tooth only by 5%, and the kind of restoration that has to be provided to the tooth largely depends on the amount of tooth structure that is remaining after root canal treatment. Mesio Occlusal Distal cavity reduces the stability of the tooth by more than 60%. As the size of the cavity increases, the deflection of the cusps also increases, and the highest deflection is seen in teeth that are endodontically compromised [15].

As opposed to the general opinion that posts increase the strength of the tooth, a number of studies have stated that the only advantage of posts is that it increases the retention of the core material and hence the decision of putting a post or not depends on the viable tooth structure that is remaining or the amount of tooth structure that is destroyed [16]. A general consensus about the indication of post-placement has not been reached and hence continued research goes on. To simplify the process, a classification of the remaining tooth associated with the indication of post-placement has been done [17] (Table 1 and Figure 3).

Class	Description
Class I	Access cavity prepared with 4 walls intact.
Class II	An M-O or D-O cavity with three walls remaining and one wall missing.
Class III	An M-O-D cavity with two walls remaining and two walls missing.
Class IV	3 walls missing, and only one wall remains.
Class V	All the walls missing, and no crown available.

Table 1: Classification of remaining tooth structure for post endodontic restoration [17].

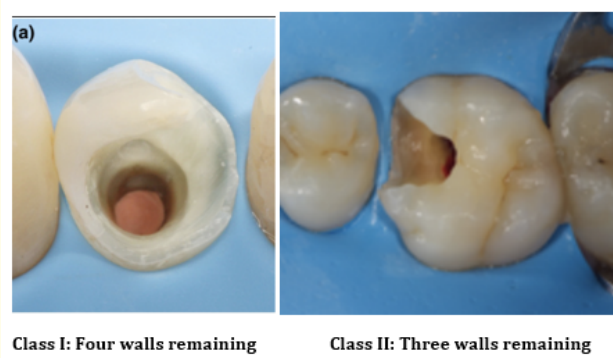


Figure 3: Classification of post endodontically treated tooth structure [21].

1 mm thickness of the cavity wall is required for increased resistance to functional load in ETT. If the thickness of the remaining wall is less than 1mm, during preparation for a crown, no dental hard tissue is left, leading to loss of tooth structure. A minimum of 1mm thickness provides stability to the core build-up material and helps in the retention of the core. The remaining height of the crown for preparation should be 2mm to achieve the ferrule effect [17].

Restoration of endodontically treated teeth

Class I

Cases where all the walls are intact and a class 1 access cavity is prepared with the remaining wall thickness more than 1 mm, no post insertion is required, and final restoration will suffice the treatment [18].

Class II/III

In cases where two or three walls are remaining, and the thickness of the wall is more than 1 mm, post-insertion is not required, and a composite resin restoration or partial coverage adhesive restoration is sufficient. In a study conducted by Steele, *et al.* they concluded that there was no difference in fracture resistance in teeth with class II/III access and untouched teeth, and hence it was stated that dental adhesive systems stabilize the teeth and increase the fracture resistance [19].

Class IV

Cases where only one wall is remaining and the tooth has to be used as an abutment for a fixed partial denture or implant, it's necessary, only a coronal restoration is not sufficient, and a post-insertion is said to increase the fracture resistance [19].

Class V

In these cases, with no remaining walls, post-insertion is necessary. The ferrule effect is also of utmost importance in teeth with coronal tooth structure remaining. A ferrule has shown to increase the fracture resistance of the tooth [20]. In case the existing crown length does not allow enough space for a ferrule, crown lengthening can be done to provide a ferrule effect [20].

Discussion

The use of endodontically treated teeth as an abutment has its own advantages and disadvantages. On the one hand, evidence shows us that it tends to increase the fracture resistance of the abutment teeth, thereby increasing the longevity of the FPD. The presence of ferrules, which is 2mm high and 1mm thick, has shown to increase the fracture resistance of the teeth even further [20]. In a study conducted by Akman., *et al*, [22], they studied endodontically treated teeth as abutments and their fracture patterns. They concluded that although there was no significant difference in fracture resistance of teeth that were sound, endodontically treated, and endodontically treated with fiber post, there was a difference in fracture pattern. Endodontically treated teeth showed more fractures in the cervical region. (Figure 4) The presence of a fiber-reinforced post definitely decreased the load on the tooth by distributing the stress due to a similar elastic modulus as that of dentin. In groups in which Fiber-reinforced composite post was applied, the fracture pattern was debonding, and the percentage of non-restorable fracture reduced [22]. (Figure 5) A lot of studies have also shown that usage of the post in endodontically treated teeth used for FPD tends to increase the strength of the tooth inside the crown [23].



Figure 4: Cervical fracture of endodontically treated teeth when used as abutment in FPD without posts [21].



Figure 5: Teeth restored with fiber post after endodontic restoration showed the only debonding type of failure and less non-restorable fracture [21].

Another finding observed in a study conducted by Gheorghe., *et al.* where they studied the prevalence of apical periodontitis concluded that a higher percentage of endodontically treated teeth were used as abutments when compared to vital teeth. They stated that the incidence of apical periodontitis was seen more frequently in teeth that were endodontically treated than in vital teeth used as abutments. But further research is required to justify this as apical periodontitis may or may not occur in teeth with a poor quality of root canal treatment that is done and sometimes occurs in teeth with an adequate root canal treatment [24].

Conclusion

Endodontically treated teeth, when used as abutments in fixed partial dentures, have to bear more load as compared to those with single crowns. When a fixed partial denture is planned for a patient, the quality of endodontic treatment done should not be ignored, the amount of bone support, quality of root canal treatment done, crown root ratio of the abutment teeth, tilt of the tooth, all these should be taken into account. Post endodontic restoration of teeth should always be done, taking into account the amount of tooth structure remaining, the kind of function the tooth has to perform after restoration. Fiber-reinforced composite posts tend to increase the strength of ETT and can be used in case the tooth has to be used as an abutment in FPDs.

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