

Original Research Article

## **Survival Rate of Endodontically Treated Teeth with Fiber Posts after Prosthodontic Restoration: A Study Review**

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**Abstract:** Dental posts are used to provide the retention of dental restorations with severe loss of hard tissue. The increasing of demand for beauty led to the invention of fiber reinforced posts, which have the numerous benefits because of favorable mechanical properties. Survivals of restorations based on fiber posts are very various and depending on during the follow-up period, the failure rate has been reported from 10% to 100%. The most common cause of failure is loss of post retention, tooth fracture or post fracture. In current study, electronic resources include PubMed, MEDLINE, ISI, Scopus are checked out with search for all Retrospective studies and Prospective Studies which were published related to evaluation, Survival rate of endodontically treated teeth with fiber posts after prosthodontic restoration until June 30, 2015. In current study 942 articles were checked and among them, 30 articles were selected. The number of samples in each article have been various between 16 to 1304 treated teeth. In the studies reviewed, Patients are followed-up for at least six months and up to 10 years, and survival rate was obtained from 48/8% to 100%. The current study showed that in clinical conditions survival rate of treated teeth based on fiber post was at an acceptable level.

**Keywords:** Fiber post, Tooth restoration, Survival

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### **INTRODUCTION**

The strength of root canal treated teeth will be reduced due to loss of tooth structure resulted from decay, repeated dental procedure and access cavity preparation during root canal treatment. It is necessary to provide a protectively restorative treatment for essential retention and resistance and to prevent from later decays of such teeth. A post and core is a technique mostly used for teeth with weakened structure. Post and core is used to supersede the poor structure of tooth for support and retention of the final crown [1]. Posts are used to provide retention of core material.

Application of post depends on the remaining dental structure. Generally, inter-canal posts are used when remaining dental structure is insufficient for restoration retention [2].

Different types of endodontic posts have been used in dentistry but none of them were completely ideal. Therefore, dentist can choose one of post systems based on essentiality of restorative treatment [3]. Cast posts have been accepted by public for a long time then prefabricated metal posts became prevalent. Different types of prefabricated metal posts (such as stainless

steel, nickel, chrome and titanium) have been used widely due to high hardness and strength. Various types of fiber-reinforced posts have been introduced in recent years. Fiber-carbon posts were firstly used in clinics in 1990. After several years, different types of white posts with glass- and quartz-fibers were introduced and supplied due to cosmetic demands [4]. In post and core systems, two types of fiber-reinforced epoxy posts are used including customized and prefabricated posts. Customized posts are those reinforced by fiberglass or polyethylene and they are directly cemented into the root canal. Prefabricated posts include carbon, quartz, silica, zirconia and glass fibers that are placed into resin epoxy and silane coupling will connect fiber to resin [2]. Fiber-reinforced posts contain carbon, quartz and glass. Resin epoxy or methacrylate is used as matrix. Fibers are placed in parallel with longitudinal axis of the post. Fibers are between 6 and 15 micrometers diameter. There are between 25 and 35 fibers per millimeter in the cross section of post. Therefore, 30-50% of cross section is covered by fiber [5]. Matrix of posts is basically made of composites which are generally epoxy polymers with high degree of conversion and highly cross-links. Most often epoxy resin or bis-GMA is used as matrix [6]. Carbon fiber posts are prepared by continuous fibers in direction of

carbon in resin epoxy matrix [31]. When using in full ceramic restorations, carbon fiber post is not able to provide desirable beauty. Therefore, transparent silica fiber posts were introduced that are known as posts reinforced with fiberglass or fiber quartz too [7]. Fiberglass posts may include different glasses such as E-glass (electrical glass) and S-glass (high-strength glass). Also, fiberglass posts can be made of fiber quartz that is pure crystalline silica and it can provide more desirable beauty [6]. Fiber posts are supplied in different shapes such as cylindrical, conical-cylindrical, conical and double tapering. Posts with parallel surfaces and conical posts provide the highest and lowest retentions respectively. Posts with double tapering have better match with canal shape after endodontic treatment thus removal of dental structure will be reduced during preparation of post space. Some commercial posts are serrate to increase retention at the end of coronal. Fiberglass posts are also supplied in oval form to match with oval canals [5].

Fiber posts contain favorable mechanical properties such as high stiffness, high strength and low toxicity [5]. Fiber posts have been especially advantageous in adhesives compared to other dental posts. Fiber posts provide favorable mechanical properties due to elastic modulus similar with dentin. Biomechanical properties of fiber posts will reduce root fracture [8]. Among advantages of fiber posts is easy restoration of root treated teeth and reduction of treatment stages compared to cast posts. In addition, removal of fiber posts is easy in case of retreatment. Moreover, fiberglass or fiber quartz posts are similar to natural teeth due to similarly optic features [5]. Restoration with post retention may cause mechanical or biologic failures [9] due to loss of retention [10]. Therefore, root canal posts should have enough tensile bonds to prevent from post separation in mouth cavity [11]. Concerning importance of post retention, the quality of cement plays a key role in successful treatment. But different reports have been published about cements because results of studies on post bond strength are contradictory. Nevertheless, there is no cement with all ideal properties [12]. Zinc phosphate is one of prevalent cements for post adhesion and if fluoride release is not necessary, it will be the first option that can provide retention because it has high clinical success in long term. Solubility and lack of adhesion to tooth structure are undesirable properties of zinc phosphate [13]. Resin cements are recommended only when post retention subjects to risky factors [14]. Such cements have technically high sensitivity and they are affected adversely by moisture thus they take a long time [16]. It is not recommended to use resin cements in narrow canals where there is no fitting due to short operating time, high viscosity and adhesive shrinkage [15, 16]. Resin cement bonding is generally influenced by C-factor above root canal because C-factor in root canal is 40 times more than coronal cavities. In root canal where there is trivial non-bonding surfaces, the

stress resulted from contraction of polymerization is not sufficiently compensated and if stress amount is more than bond strength, a gap will be created in contact surface area of cement-dentin [17]. Concerning such disadvantages, conventional glass ionomer cements (GIC) or resin-modified (RMBIC) cements are used for cementing fiber posts. In such cements, micro-mechanical mechanisms and chemical bonding are used for dentin bonding. Although such cements undergo contraction due to polymerization, hygroscopic extension will reduce somewhat the stresses. RMBIC is superior to GIC due to lower sensitivity to moisture, high dimensional stability and formation of strong bond into dental structure [17].

According to clinical studies, it seems that posts do not reinforce strength of root treated teeth. However, studies show that fiber posts are superior to metal posts and they are less probable to cause root fracture [18]. On this basis, nowadays, fiber posts are used increasingly for restoration of root treated teeth. In most clinical studies that evaluated survival of such restorations, application of fiber posts was very promising [19].

The most prevalent failures of post-based restorations include loss of post retention, tooth crack or post fracture [20, 21]. Treatment failure can associate with dental factors (remaining structure, ferrule length, periodontal position, proximal and anterior teeth and Para-functional habits) or factors related to post (post's length and diameter, tapering degree and post matrix) [22]. Different factors may involve in life cycle of post-based restorations such as control of moisture into root canal, anatomic variations and cavity shape. Such factors cause non-uniform etching and bonding in post space wall and incomplete polymerization of cement in deep areas of root canal [23].

Restorations based on cast posts and prefabricated posts have acceptable survival. Studies showed life cycle of cast post restorations between 3.7 and 13.5 years and it depends on different factors such as type of restoration, anatomic position (up or down jaw), type of tooth (anterior or posterior), number of posts and cement [24, 25]. The study conducted by Gomez-Polo *et al* showed life cycle of prefabricated post-based restorations as high as cast posts [26].

Survival of fiber post-based restorations is very various and failure has been reported between 10 and 100% depending on follow up period [27, 29]. Systematic study of Figueiredo *et al* showed that survival of metal posts and fiber posts was 90 and 83.9% respectively. They found that generally root fracture is similar in metal and fiber posts and frequency of root fracture in carbon fiber posts is two times higher than fiberglass posts [30].

Life cycle of post-based restorations may change due to different factors such as moisture into root canal, anatomic variations and cavity shape (non-uniform distribution in etching and bonding stages), incomplete polymerization of cement in deeper areas (due to lack of optical percolation), chemical incompatibility between adhesive and cement and also post design, length and thickness, cementing process and remaining dental material. The most endodontic failures restored with fiber posts associate with post bonding resulted from stress accumulation between cement and post. Such failures have been reported in laboratory studies rather than clinical studies. In clinical studies, bonding, post traumatic fracture and build up core fracture have been reported as the most common reasons. Regarding bonding, most failures are occurred between cement/adhesive and dentin rather than contact surface area of cement and post [28].

Some clinical studies indicated that the most common failure of post-based restorations is separation of post. Since retention of fiber posts in root canal is passive, effectiveness of cement and cementing play important roles in clinical efficiency of restoration. However, a stable adhesion to intra-radicular dentin in apical area has been remained as a clinical challenge because some factors may affect adversely cement adhesion via structural change of ivory or disturbance in resin polymerization including substances used during endodontic treatment such as sodium hypochlorite, EDTA, hydrogen peroxide, RC Prep and calcium hydroxide, Eugenol in medicaments and sealers. When preparing post space, some part of dentin that was changed by such chemical factors will be removed [5].

Some factors are effective on survival of post-based restorations. Factors related to post such as length, diameter, tapering intensity and type of post matrix are effective on survival of such restorations. Type of matrix is determinant in translucency intensity and light passage. Factors related to cement include contraction of curing, curing light passage into deep area, chemical incompatibility with adhesive and moisture control. Extreme thickness of cement around post will increase probability of post separation from cement due to increase of pores and spaces between cement and root dentin. Cement thickness depends on root area, shape and matrix of post [27].

Since current studies have investigated survival of post-based restorations in different time periods ranging from one to ten years [29, 31] and survival has been reported differently, it is necessary to conduct review studies and to identify survival rate of teeth restored by posts. Therefore, the present study is going to evaluate survival of root treated teeth by using fiber post.

## METHODS AND MATERIALS

In this review study, electronic sources including MEDLINE, PubMed, ISI and Scopus were searched using key words and MeSH such as Fiber post and clinical study, Fiber post and clinical evaluation, root post and retrospective survival study and cast post-and-core and clinical study. The searches were done for all retrospective and prospective studies published until 30.June, 2015. These English studies were conducted on survival of teeth restored by fiber post in human beings. Papers with case reports and therapeutic techniques were excluded from the study. After revision of abstracts and checking their connection with post survival, complete text of papers or a summary of them were included in the study and they contained information about number of restored teeth, follow up time duration and survival rate.

**Table 1: search keywords**

Keyword
Fiber post and clinical study
Fiber post and clinical evaluation
Root post and retrospective survival study
Cast post-and-core and clinical study

## DISCUSSION

In current study, review of 30 clinical papers showed that survival rate of post-based restorations was between 48.8 and 100% from 6 months to 10 years of follow up. Dikbas and Tanalp evaluated 24 clinical studies about life cycle of fiber post-based restorations. Studies were continued from one to ten years. Survival rate was between 48.8 and 100% at the end of follow up [32].

In this study, the survival of restored tooth was considered as the time interval between tooth restoration and treatment failure for any reason [33] or the end of study period without any treatment failure. In studies under consideration, treatment failure was determined based on identification of negative results in clinical examinations or radiographic evaluation as follows:

- Tooth problem: secondary decay, root fracture
- Restoration problems: separation of crown, fracture of restoration
- Post and core problems: loss of post retention, post deformation, de-bonding of post and core, fracture of post or core.
- Tissue lesions: periapical, periradicular or periodontal lesions
- Endodontic problems

Contradictory reasons have been mentioned in previous studies about clinical failure of fiber post restorations. Generally, clinical studies indicate that the most important causes of failure in post-based restorations include post separation, post fracture and tooth or core fracture [21, 35]. A review study showed

that secondary decays, loss of retention and de-bonding of post and core, root fracture, post deformation and fracture have been identified as causes of treatment failure [33]. Some studies identified post separation as the most common cause of post-based restorations [34-36] although another study showed post fracture (41%) then post separation (34%) as the most common causes of treatment failure [37]. Cagidiaco *et al* showed in a clinical study that fiber post-based restorations caused post separation in 4.3% of cases during two years and such restorations caused endodontic problems in 3% of cases thus treatment failure [38]. Different results about causes of treatment failure may be due to different clinical conditions. Naumann *et al* found that tooth position, presence of proximal teeth and type of final treatment can be effective factors on life cycle of post-based restorations. They indicated that amount of failure in anterior teeth (compared to posterior teeth), teeth without proximal contact (compared to those with at least one proximal tooth) and crowned teeth (compared to stable bridges) was considerably high [39]. Bru *et al* reviewed factors affecting clinical performance of posts and found that prognosis of fiber posts in posterior teeth is more favorable than anterior teeth. Remaining dental structure and high number of proximal contacts will improve prognosis of teeth restored by post [27]. Some conditions of patient can be effective on survival of post-based restoration. It has been shown that probability of failure is high in patients who have incomplete teeth, individuals with Para-functional habits and anterior teeth [40]. According to report of Mehta and Millar, type of cement is considerably effective on successful fiber post-based restorations. They noticed that rate of successful restoration with fiber-white parapost was 79.5% when using cement type Panavia F 2.0 (35 cases out of 44 restorations during 28-50 months) compared to application of cement type Calibra with 64.1% of successful treatment (41 restorations out of 64 restorations during 38-54 months) [40].

Generally, the most important cause of failure in fiber post restoration is bond failure in contact surface area of cement and dentin while intense stress on dentin and root fracture are the most important factors that cause failure of metal posts [27]. Subramanian *et al* found that composite resin posts reinforced with fiber will provide better match and retention compared to metal posts [41] although Soares *et al* showed in a review study that fiberglass posts had similar efficiency to metal posts in clinical condition. In cases of treatment failure, restorations done with metal posts are generally irreversible whereas teeth restored by fiber post are treatable in case of treatment failure [42].

## CONCLUSION

Present review study indicated that fiber post-based restorations have acceptable survival in clinical condition. Nevertheless, in case of treatment failure due

to post separation from canal space, such restorations can be retreated thus they are superior to metal post-based restorations.

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