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Original article

Clinical evaluation of the fiber post and direct composite resin restoration for fixed single crowns on endodontically treated teeth

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ABSTRACT

Background: The restoration of an endodontically treated fractured tooth has been a challenge for restorative dentists for decades. The performance of fiber posts when used in conjunction with direct composite resin restorations have been largely unreported. This study was conducted with the aim of evaluating the survival rate of endodontically treated teeth restored with adhesive bonded fiber reinforced resin posts and direct composite core with additional crown coverage.

Methods: Sixty patients who required endodontic treatment with post core crown were selected from outpatient department of Air Force Institute of Dental Sciences, Bangalore. Sixty-four teeth were endodontically treated and restored with fiber post and direct resin composite core restoration. Patients were evaluated immediately after restoration and reevaluated at the end of first, second and third months. After 3 months of clinical evaluation, if teeth were asymptomatic they were restored with complete coverage porcelain fused to metal restorations and evaluated immediately, and again reevaluated at the end of first, third, and sixth months.

Results: After 3 months of clinical evaluation, only two teeth exhibited periapical lesion with clinical symptoms and three teeth without any clinical symptoms. Five teeth exhibited slight marginal staining, three teeth showed partial loss of restoration, and two teeth exhibited complete loss of restoration with the fracture of the post. At the end of sixth month after restoration with full coverage crown, two teeth had dislodged restoration due to fracture of post and two teeth exhibited displacement of the post.

Conclusion: Fiber posts are the best alternative for restoration of fractured endodontically treated teeth. Fiber posts and direct composite resin core materials are strongly recommended for restoration of endodontically treated mutilated teeth among the dental establishments of Armed Forces.

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Introduction

The restoration of an endodontically treated fractured tooth has been a challenge for restorative dentists for decades. The traditional and accepted method is to restore the tooth with a post and core restoration that may be covered with a crown. Until the mid-1980s, the cast metal post, made indirectly in the laboratory, was considered the safest way to restore an endodontically treated tooth.^{1,2}

Performing the treatment directly in patient's mouth with prefabricated metal posts is common as it is less time consuming and economical.³ But these metal posts are rigid which induce stress and cause root fracture. The need for favorable esthetic requirements combined with these failures was predisposing factors for development of new post materials.

In the 1990s, fiber-reinforced composites (FRC) posts were introduced as an alternative to traditional custom made cast post and prefabricated metal posts. The early versions were constructed of carbon fiber embedded in a resin matrix and these posts when compared to metal posts possessed different physical properties. Unfortunately, their use met with some resistance as they were black in color, leading to poor aesthetics under all-ceramic restorations. Subsequently, more esthetic quartz and glass fiber reinforced composite posts were introduced as an esthetic alternative to carbon posts.

Fiber-reinforced composite posts along with composite resin core material have become more popular in restoring endodontically treated mutilated teeth because of properties like modulus of elasticity resembling dentin, high retention, better translucency, better transmission of forces with reinforcement of restoration & excellent esthetics.

The need for full coverage restoration of the tooth after root canal treatment is still conjectural and no recent clinical study is available to confirm the indications given in the literature⁴ and has been routinely recommended as a protective measure in clinical practice.⁵ Although retrospective studies reported good clinical performance when a complete crown was given after tooth buildup, the performance of fiber posts when used in conjunction with direct composite resin restorations as tooth buildup remains largely unreported. Hence, this study was conducted with the aim of evaluating the survival rate of endodontically treated teeth restored with adhesive bonded fiber reinforced resin posts, with direct composite core and additional crown coverage.

Materials and methods

Sixty patients (35 men and 25 women) were randomly selected for the study from outpatient department of Air Force Institute of Dental Sciences, Bangalore. They required endodontic treatment and restorations on 42 anterior teeth and 22 posterior teeth (12 premolars and 10 molars) ($n = 64$ teeth overall). The mean age of the patients was 33.36 years (range 19–52 years). Inclusion criteria were the clinical and radiographic confirmation of the need for root canal treatment and availability of sufficient tooth structure for restoration.

The endodontic procedure was performed using a crown-down technique. A portable endodontic motor was used with speed and torque adjusted according to manufacturer's instructions. A chelating agent EDTA (Largal Ultra) and 2.5% sodium hypochlorite were used to clean the pulp chamber at the beginning of instrumentation. All teeth were instrumented with rotary (protaper) instruments up to the working length as indicated by apex locator. The prepared canals were obturated with gutta-percha points using root canal sealant (endomethasone) and lateral condensation using hand pluggers.

Once the teeth were clinically and radiologically asymptomatic, the Gates Gladen drill was used to remove root canal filling material leaving minimum 5 mm of apical seal. Biomechanical preparation was done with a low speed bur creating the post space to 9–10 mm.

The root canal walls were etched with 37% phosphoric acid for 15 s, washed with water spray and then gently air dried. The excess water was removed using paper points. Part A and Part B of the adhesive bonding agent were mixed in equal proportions and two coats were applied to root canal walls with a micro brush and gently air dried. Translucent glass fiber posts were cemented with dual cure resin cement. Both catalyst and base paste of the dual cure resin cement was mixed on mixing pad, coated to the post. Excess resin cement was removed with clean micro brush and the cement was light cured for 40 s. Building up of the tooth was done with direct resin composite restoration using layering technique. Finishing and polishing of the core was done with fine diamond burs and multi laminated carbide burs. Final polishing was done with aluminum oxide points and silicone brush.

Patients were recalled at the end of first, second and third month subsequently for clinical and radiographic evaluation like presence or absence of periapical lesion, marginal leakage and integrity, color stability, surface staining and loss of retention due to fracture of the post or composite buildup material. The restorations were evaluated by two operators who were not involved with the restorations and who were not revealed at the time of recall (single-blind trial).

After 3 months of clinical evaluation, the asymptomatic teeth were taken up for complete coverage porcelain fused to metal restorations. Out of 64 teeth involved in the study 60 were selected for further restorations. The teeth were prepared for full coverage crowns in the conventional way, impressions were made with rubber base impression material, individual dies were prepared and porcelain fused to metal (PFM) crowns were fabricated in the lab. These crowns were luted to the prepared teeth using dual cure adhesive resin as per manufacturer's instructions.

These teeth restored with PFM crowns were evaluated clinically and radiographically for any periapical lesion and loss of retention after a further period of 1, 3 and 6 months.

Results

Tables 1–4 show the recall data obtained at the end of 1, 2, and 3 months after restoration with fiber post and direct

Table 1 – Recall data on periapical lesion and marginal leakage.

	Time of evaluation	A	B	C	Kaplan–Meier survival probability estimate	95% CI
Periapical lesion for 64 teeth	Base line	64 (100%)	0 (0%)	0 (0%)	1	0.930–1
	1 month	64 (100%)	0 (0%)	0 (0%)	1	0.930–1
	2 months	61 (95.31%)	2 (3.12%)	1 (1.56%)	0.953	0.860–0.988
	3 months	59 (92.19%)	3 (4.69%)	2 (3.12%)	0.922	0.820–0.971
A – Absent		B – Present but without symptoms		C – Present to be retreated		
	Time of evaluation	A	B	C	Kaplan–Meier survival probability estimate	95% CI
Marginal leakage	Base line	64 (100%)	0 (0%)	0 (0%)	1	0.929–1
	1 month	62 (96.87%)	2 (3.12%)	0 (0%)	0.969	0.882–0.995
	2 months	59 (92.19%)	4 (6.25%)	1 (1.56%)	0.922	0.820–0.971
	3 months	57 (89.06%)	5 (7.81%)	2 (3.12%)	0.891	0.782–0.951
A – Excellent continuity at restoration tooth interface, no discoloration		B – Slight discoloration at the interface		C – Moderate discolorations at restorative tooth interface measuring 1 mm or greater or recurrent decay at the margins and need for replacement		

composite resin core. Table 1 contains data on periapical lesion & marginal leakage, Table 2 contains data on retention & color stability, Table 3 on surface staining and Table 4 on recall data on restorations with porcelain fused to metal (PFM) crowns. All the recall data are expressed as number of failures and percentage of failures at particular time of follow-up. The data was subjected to statistical analysis using statistical software. Survival probability was estimated using Kaplan–Meier survival probability estimate. Lower and upper limits of

95% of confidence interval of survival probability was calculated according to Robert Newcombe efficient score method.

After 3 months of clinical evaluation, endodontic retreatment was performed on patients with persisting periapical lesions or clinical symptoms. Only two teeth exhibited periapical lesions with clinical symptoms and three teeth without clinical symptoms. Five of 64 teeth examined exhibited slight marginal staining. They were successfully repaired using the same material used for the restoration. Two teeth with

Table 2 – Recall data on retention and color stability.

	Time of evaluation	A	B	C	Kaplan–Meier survival probability estimate	95% CI
Retention	Base line	64 (100%)	0 (0%)	0 (0%)	1	0.930–1
	1 month	64 (100%)	0 (0%)	0 (0%)	1	0.930–1
	2 months	62 (96.87%)	1 (1.56%)	1 (1.56%)	0.969	0.882–0.994
	3 months	59 (92.19%)	3 (4.69%)	2 (3.12%)	0.922	0.820–0.971
A – Present		B – Partial loss		C – Complete loss		
	Time of evaluation	A	B	C	Kaplan–Meier survival probability estimate	95% CI
Color stability	Base line	64 (100%)	0 (0%)	0 (0%)	1	0.929–1
	1 month	62 (96.87%)	2 (3.12%)	0 (0%)	0.969	0.853–0.995
	2 months	61 (95.31%)	3 (4.69%)	0 (0%)	0.953	0.860–0.988
	3 months	60 (93.75%)	4 (6.25%)	0 (0%)	0.938	0.840–0.980
A – No mismatch		B – Slight discoloration not requiring replacement		C – Discoloration requiring replacement		

Table 3 – Recall data on surface staining.

Time of evaluation	A	B	Kaplan–Meier survival probability estimate	95% CI
Base line	64 (100%)	0 (0%)	1	0.929–1
1 month	62 (96.87%)	2 (3.12%)	0.967	0.882–0.995
2 months	61 (95.31%)	3 (4.69%)	0.953	0.860–0.988
3 months	59 (92.19%)	5 (7.81%)	0.922	0.820–0.971

A – Absent; B – Present.

marginal discoloration were treated by replacement of the entire core. Three of 64 teeth showed partial loss of restoration, which was manifested as chipping of resin composite and was repaired using same resin composite. Two teeth exhibited complete loss of restoration with the fracture of the post. They were treated with fresh post core restoration. After 3 months of evaluation, four teeth showed slight discoloration that did not require restoration replacement. Surface staining was present in 5 of 64 teeth after 3 months of clinical service and was readily removed with polishing.

Table 4 demonstrates recall data at first, third and sixth month after complete coverage of the endodontically treated asymptomatic teeth with PFM crowns.

Out of 64 teeth selected for the study, 60 teeth were asymptomatic at the end of 3 months and they were selected for full coverage PFM restoration. After cementing PFM crowns they were again reevaluated at the end of 1, 3 and 6 months. At the end of sixth month, only two teeth had dislodged restoration due to fracture of post and two exhibited displacement of the post.

Discussion

At present, the fabrication of cast metal post using indirect technique or prefabricated metal post with composite resin core buildup are widely used to restore grossly decayed endodontically treated teeth in Armed Forces dental centers. Metal posts were most often used because of their physical properties, with some limitations. Arturo's experiment⁶ showed that the major problem with the tooth restored by metal post system is tooth fracture because of stresses induced, whose ratio runs as high as 91%. This clinical disadvantage of metal post system could be overcome by use

of fiber post system. Frederickson et al⁷ carried out a clinical retrospective study on 236 patients restored with fiber posts and concluded that the fiber post has similar modulus of elasticity as dentin, and the stress can be evenly distributed around the post, which saves the post or the root from fracture, which is often caused by over concentration of stress as in case of metal post systems.⁸

At the end of 3 months after root canal treatment and restoration with fiber post and composite resin core, it was noticed that only two teeth exhibited periapical lesions with clinical symptoms after 2 months and three teeth after 3 months. Five of 64 teeth examined exhibited slight marginal staining, which were successfully repaired using the same material used for the initial restoration. Two teeth with marginal discoloration were treated by replacement of the entire core. Three of 64 teeth showed partial loss of restoration, which was manifested as chipping of resin composite and were repaired using same resin composite used for the initial restoration. Two teeth exhibited complete loss of restoration with the fracture of the post. They were treated with fresh post and core restoration. After 3 months of evaluation, four teeth showed slight discoloration that did not require replacement of restoration. Surface staining was present in 5 of 64 teeth after 3 months of clinical service and was readily removed with polishing. These results suggest that restoration of endodontically treated teeth with fiber posts and direct resin composites is a good treatment option, in short, conserves remaining tooth structure and has good patient compliance. However, longer clinical trials with higher sample size should be performed to validate the use of fiber post and direct resin composites which can be utilized as a simplified conservative approach to rehabilitate endodontically treated tooth [Fig. 1].

Table 4 – Recall data on restorations with PFM crowns.

Time of evaluation	A	B	C	Kaplan–Meier survival probability estimate	95% CI
Base line	60 (100%)	0 (0%)	0 (0%)	1	1–0.925
1 month	60 (100%)	0 (0%)	0 (0%)	1	1–0.925
3 months	58 (96.67%)	1 (1.67%)	1 (1.67%)	0.967	0.875–0.994
6 months	56 (93.33%)	2 (3.33%)	2 (3.33%)	0.933	0.830–0.979

A – Teeth with intact post core and PFM crown; B – Teeth with dislodged restoration due to fracture of the post; C – Teeth with dislodged restoration due to displacement of the post.

Fig. 1 – Fiber post in relation to right maxillary lateral incisor.

At the end of sixth month, out of 60 teeth selected and restored with full coverage PFM crowns [Fig. 2], two teeth had dislodged restoration due to fracture of post and two exhibited displacement of the post. The failure rate of endodontically treated teeth restored with fiber post – composite resin core and PFM crown at the end of 6 months was 6.66%. Ferrari et al reported a 3.2% failure rate in retrospective study of the clinical performance of fiber posts after clinical service ranging from 1 to 6 years.⁹ Frederickson et al reported that 98% of teeth survived after an evaluation period of 2.4 years.⁷

Results of this clinical trial were quite satisfactory and are in accordance with trials performed by Grandini et al.¹⁰ The results of this clinical trial are important since, in this study direct resin composite restorations were studied, whereas many of the prospective and retrospective studies evaluated fiber post resin restorations that were covered with either full ceramic or metal ceramic crowns.⁹ In this study, the clinical performance of fiber posts was analyzed with due regards to preservation of the tooth structure which is the most important aspect in increasing the survival rate of endodontically treated teeth.

Fig. 2 – Porcelain fused to metal (PFM) crown over maxillary lateral incisor reinforced with fiber post.

The causes of failure in this study were post and core fracture or dislodgement. These failures did not compromise the remaining dental structures, allowing the retreatment with new post and core with same material and technique. These failures could be attributed to some adhesion/cohesion defects within the composite reinforced structures during clinical procedures.

Conclusion

Restoration of endodontically treated teeth with fiber posts and composite resin core material is one of the most well-documented, scientifically-supported techniques available. Two decades of research have reinforced time and again the merits of fiber posts over other traditional prefabricated or custom fabricated post systems. Because of numerous clinical advantages, fiber post system has become more popular in restoring endodontically treated teeth.

Conventional methods of post and core systems like cast metal post and prefabricated metal post have their own limitations. This study shows that fiber posts are the best alternative due to their various advantages and excellent clinical performance. Building up of the core immediately after cementation of fiber post with direct composite resin core materials using layering technique is strongly recommended as an interim restoration since it effectively reinforces residual tooth structure and is also less time consuming. Within the limitations of the study, Fiber posts and direct composite resin core materials are strongly recommended for restoration of endodontically treated mutilated teeth.

Long term studies with bigger sample size will be required to assess the longevity of these restorations.

Conflicts of interest

All authors have none to declare.

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