

## Nonmetallic post-endodontic restorations: A systematic review

*Restaurações a pino não metálicos pós endodontia: uma revisão sistemática*

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### ABSTRACT

To test the hypothesis that the placement of nonmetallic post in endodontically treated teeth is associated with improved survival rate of the restored teeth, using a systematic reviewing process of clinical studies. Papers referring to post-endodontic on restorative teeth were located by MEDLINE search with limitation of search to the first selection criteria. Study selection: A three-step inclusion-exclusion procedure was applied to identify papers that represented; comparative study, clinical study, papers in English, human study, restorations for more than 2 years of follow-up, restorations with non-metallic post with single crown and those with consistency of data. Application of the third selection resulted in five studies in which, 638 restorations were done and resulted in survival rates that ranged from 96% at 2 years to 94% at 8 years.

**Key words:** Dental materials; Post and core technique; Dental restoration failures.

### RESUMO

Para testar a hipótese de que a colocação de núcleos não metálicos em dentes tratados endodonticamente está associado a taxa de sobrevivência dos dentes restaurados, utilizou-se um processo de revisão sistemática dos estudos clínicos. Artigos referentes a colocação de pinos para restauração dos dentes foram localizados por busca no MEDLINE com limitação da pesquisa para os critérios de seleção primeiramente. Estudo de seleção: um procedimento de três passos de inclusão-exclusão foi aplicado para identificar artigos; estudo comparativo, estudo clínico, artigos em inglês, estudos em humanos, restaurações com mais de 2 anos de acompanhamento, restaurações com pinos não metálicos com única coroa e aqueles com consistência dos dados. A aplicação da terceira seleção resultou em cinco estudos nos quais 638 restaurações foram realizadas e resultaram em uma taxa de sobrevivência que variou de 96% aos 2 anos para 94% aos 8 anos.

**Palavras-chave:** Materiais dentários; Técnica do pino e núcleo; Falhas em restaurações dentárias

### INTRODUCTION

Posts are generally indicated for restoring endodontically treated teeth that are highly susceptible to fracture because of their insufficient coronal tooth structure<sup>1-3</sup>. Prefabricated posts were traditionally made of metal and might be visible through the structure of endodontically treated teeth, particularly in anterior region<sup>4</sup>. Also, they might have different degrees of stiffness<sup>5,6</sup>. Nonmetallic posts are made either from a resin matrix reinforced with carbon, glass or quartz fibers<sup>7</sup> or from ceramic materials<sup>8</sup>. With the exception of carbon posts, these posts showed more favorable esthetics in anterior teeth when restored with all-

ceramic crowns due to their light-transmitting capacity in addition to their modulus of elasticity values that are similar to that of dentine<sup>7</sup> and this can reduce the risk of tooth fractures and in turn can increase their survival rates when compared to teeth restored with metallic posts<sup>9</sup>. Also, these posts are able to form a monoblock structure created by dentin, resin cement and post<sup>4</sup>.

The systematic reviewing process enables the aggregation of results from different studies comparing different types of posts and aims to provide the current best available evidence upon which clinical decisions regarding the selection of endodontic posts can be based.

The objective of this study was to test the hypothesis that the placement of nonmetallic post in endodontically treated teeth is associated with improved survival rate of the restored teeth, using a systematic reviewing process of clinical studies.

**MATERIAL AND METHODS**

The literature search was conducted using a PubMed database search in the library of the faculty of dentistry-University of Toronto. The Search involved the years from 1971. Keywords were "post" and "endodontic". Abstract texts were not included and the search was limited by "language", "type of article" and "clinical study" showed in table 1. The second selection excluded papers with follow up periods shorter than 2 years" and those used "metallic post". A third step in the selection procedure was carried out to assess the quality of the papers. Studies that had no consistency of data were excluded. The assessment of the quality of papers was necessary to obtain standardization for this systematic reviewing.

Table 1. Selection criteria for this study

Step	Includes	Excludes
First selection	Comparative Study	Cases reports
	Clinical study	Non-comparative Study
Second selection	Paper in English	Non-clinical study
	Human study	Paper in other language
Third selection	Follow up 2 years or more	Animal study
	Non-metallic post	Follow up period shorter than 2 years
Third selection	Consistency of data	Metallic post
	Single crowns	Inconsistency of data

**RESULTS**

The first selection revealed 157 studies. The second selection revealed 10 papers that are shown in Table 2<sup>7,10-18</sup>. In the third selection process, one study was excluded for using metallic posts and two were excluded due to lack of consistency of data. Another two studies were excluded due to the use of bridges rather than single crown restorations. The 5 papers that survive after the third selection are shown in Table 3 (presented in italics).

Cagidiaco et al.<sup>10</sup> reported the clinical performance of fiber post restorations in endodontically treated teeth. Two operators treated a total of 150 patients between February and July 2003 at the Department of Restorative Dentistry of the University of Siena. The age of patients ranged from 18 to 75 years (mean: 56 years). Among the teeth included in the study 35.2% of them were anterior teeth and 64.8% were posterior teeth. The teeth were previously endodontically treated and the roots were prepared to receive posts. The quartz fiber posts (DT light post) were used and after the root canal spaces were prepared to a length of 8 mm according to the manufacturer. The used cement was Calibra resin cement (Dentsply Caulk) combined with Prime & Bond NT adhesive system (Dentsply Caulk) and the cementation procedure was performed according to the manufacturers' instructions. Crowns and direct resin composite restorations were placed in 74.7% and 25.3% of the teeth respectively. During the follow-up periods (23 to 25 months), only 7.4% of the cases showed failure. The failure mode in 4.3% of the failed cases was post debonding occurred in crown-restored teeth where the others 3.1% of cases had periapical pathology. Debonding occurred in anterior teeth and in 3 posterior teeth where the restored teeth had no remaining coronal walls prior to treatment.

Table 2. Papers selected after second selection (in alphabetical order; n = 10) (studies excluded by third selection step in *italic*)

Cagidiaco et al. 2007
<i>Ferrari et al. 2000</i>
<i>Ferrari et al. 2007</i>
Grandini et al. 2005
Monticelli et al. 2003
<i>Naumann et al. 2005</i>
<i>Neumann et al. 2007</i>
Piovesan et al. 2007
Turker et al. 2007
<i>Wegner et al. 2006</i>

Grandini et al.<sup>12</sup> conducted a clinical evaluation of the use of fiber posts and direct resin composites for restoring root-treated teeth. Eighty-one patients were treated in three private dental offices between January and February 2002. A total of 90 teeth were restored, 42.1% of the teeth were anterior teeth and 68.9% of them were posterior teeth. The mean age of

the patients was 35.17 years (range, 15 to 56 years). All teeth were endodontically treated and the root canal spaces were prepared to a length of 9 to 10 mm. The Duolink resin cement (Bisco) was used for cementation of quartz fiber posts (DT light post, RTD). The restorative procedure was completed with direct resin composites. After 30 months, only 4 teeth exhibited

periapical lesions and in 1 case, retreatment was performed without replacing the direct restoration. Five teeth showed a partial loss of the restoration. Six teeth exhibited slight marginal staining. After 2 years of clinical service, 4 teeth showed slight discoloration without the need of restoration replacement and eight teeth showed surface staining.

Table 3. Details of the five studies included in this systematic reviewing

Reference	Type of Study	No. of clinicians and examiners	No. of patients	Age of patients (years) and mean	Position and No. of teeth		Post Type	Cement Type	Follow-up period(months)	No. and % failures	Causes of failure
					Anterior	Posterior					
Cagidiaco et al.	Clinical study	2	150	18-75 (56)	57	105	Quartz fiber post (DT light Post)	Calibra resin cement	23-25	12 (7.4)	Post debonding-Periapical Pathology
Grandini et al.	Clinical Study	3	81	15-56 (31)	38	62	Quartz fiber post (DT light Post)	Duo-link resin cement	30	4 (4)	Periapical pathology
Monticelli et al.	Prospective study	N/A	225	18-78 (51)	-	225	Glass fiber post (Aesthetic Plus Post) Quartz fiber post (DT light Post) Fiber-reinforced composite (Postec Post)	Duo-link resin cement Multilink resin cement	24	14 (6.2)	Post debonding-Periapical pathology
Piovesan et al.	Prospective clinical study	1	69	N/A	36	73	Polyethylene ribbon post (Ribbond post)	Enforce resin cement	86-94	6 (5.5)	Post fracture-Post dislodgement
Tuker et al.	Prospective clinical study	N/A	28	(34.53)*	31	11	Polyethylene ribbon post (Connect Reinforcement Ribbon)	Resin cement**	10***-73	1	Post debonding

DT Light Post, RTD, St. Egreve, France  
Ribbond Post, Ribbond, Seattle, USA  
Connect Reinforcement Ribbon, Kerr Corporation, Orange, USA

Aesthetic Plus Post, RTD, St. Egreve, France  
Postec Post, Ivoclar Vivadent, Schaan, Liechtenstein

Calibra, Dentsply Caulk, Milford, DE  
Duo-link, BISCO, Schaumburg, USA

Multilink, Ivoclar Vivadent, Schaan, Liechtenstein  
Enforce, Dentsply Caulk, Milford, DE

\* The paper did not show the variation of age.

\*\* Not specifically mentioned.

\*\*\* Only one patient experienced dentin-cement failure as a result of debonding of the post after eleven months in service.

Monticelli et al.<sup>13</sup> conducted a 2-year retrospective study of fiber posts. Two hundred twenty-five patients were treated in the Department of Restorative Dentistry, University of Siena. The mean age of the patients was 51 years (range, 18 to 78 years). This treatment was planned for premolars that presented with only two coronal walls left and only one post was placed in each premolar. The root spaces were created about 9 mm deep. Seventy-five patients received Aesthetic Plus posts

(RTD), 75 patients received DT light posts (RTD) and others 75 patients received Postec posts (Ivoclar-Vivadent). Aesthetic Plus posts and DT light Posts were cemented with Duo-link resin cement (BISCO) combined with One-Step bonding system and Postec posts were cemented with Excite DSC adhesive and Multilink resin cement (Ivoclar-Vivadent). Cementation procedures were done following the manufacturer's instructions. All teeth were covered with porcelain-crowns. Follow-up was for 24 months and showed only 6.2% failures,

similarly distributed among the three post groups tested. Eight restorations failed due to post debonding (3.5%). Six restorations (2.7%) were failed due to the recurrence of periapical pathology.

Another prospective study was done by Piovesan et al.<sup>16</sup> to evaluate polyethylene fiber-reinforced posts and cores used in endodontically treated teeth. Sixty-nine patients from a private dental office were studied. The age of patients were not reported by authors. One operator placed all 109 post-and-core restorations. 33% of the restored teeth were anterior teeth and 67% were posterior teeth. The root spaces were prepared for a length of 7 to 10 mm depending of tooth. A 2 mm-wide ultrahigh-molecular-weight polyethylene fibers (Ribbeond, Ribbond Inc) were used. The posts were cemented with Enforce (Dentsply Caulk). Teeth received ceramic-fused-to-metal crowns, all-ceramic crowns, or direct resin composite restoration. The mean follow-up period was 90.2 months. Failures of anterior teeth occurred twice in metal-ceramic crowned, 1 in all-ceramic crowned and 1 in resin composite restored teeth and the cause of failure was post fracture. For posterior teeth, failure occurred in 2 all-ceramic crowned teeth due to post dislodgement and post fracture.

Turker et al.<sup>17</sup> conducted a prospective clinical study to evaluate ribbon-reinforced polyethylene fiber post. A total of 28 patients were treated during 6 years period and the mean age was 34.53 years. 73.8% of the restored teeth used in this study were anterior teeth and 26.2% were posterior teeth. The teeth were treated with 3-mm-wide polyethylene fiber ribbon (Connect Reinforcement Ribbon, Kerr Corp). Resin cement was used for luting the polyethylene fiber ribbon-reinforced posts. Syntac Primer, Syntac Adhesive and Heliobond (Ivoclar Vivadent) were applied according to manufacturers' instructions. Teeth were covered with Empress II all-ceramic crowns (Ivoclar Vivadent) that were cemented with resin cement. The follow-up periods were 10 to 73 months. Only 1 post dislodgement due to debonding was observed after 11 months of clinical use.

## DISCUSSION

The results of the five clinical studies<sup>10,12,13,16,17</sup> showed that nonmetallic posts lasted for 5 years so some overall conclusions can be drawn out about the

performance and longevity of nonmetallic posts. Among the teeth included in these studies 25.4% of them were anterior teeth and 74.6% of them were posterior teeth. The survival rates ranged from 96% at 2 years to 94% at 8 years. The majority of failures were due to post debonding. Almost all of the debondings occurred in cases where posts were bonded to teeth with less than 2 mm of dentin structure left at the coronal level<sup>10,13</sup>. In addition, debonding of the posts might be caused by difficulty of retention of the posts to intraradicular dentin<sup>19-21</sup>. Also, failure of the fiber non-metallic posts was not associated with root fractures. Post fracture occurred in six teeth, 4 of them were anterior teeth and 2 were posterior teeth. Two of the anterior teeth were restored with metal crowns, one with all-ceramic and one tooth was restored with resin composite restoration. For posterior teeth, two teeth were restored with All-Ceramic crowns. In all cases, the polyethylene fiber-reinforced posts were used. Post dislodgment was observed in only 1 case after 11 months follow-up. The use of non-metallic post is commonly repairable when the post fracture occurred<sup>13,14,22-24</sup>.

The posts used in these studies were 52.5% quartz fiber posts, 13.2% glass fiber posts, 13.2% fiber-reinforced composite posts and 21.1% Polyethylene ribbon posts. The follow-up period was up to 7 years. Comparing the posts failures separately, 5% of failures occurred in quartz fiber posts, 8% in fiberglass posts, 5.3% in fiber-reinforced composite posts and 5.8% in polyethylene ribbon post (Figure 1).

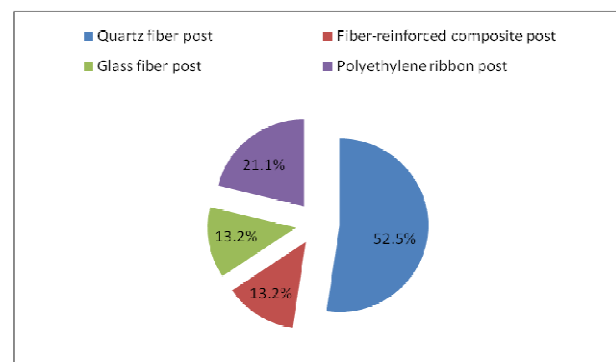


Figure 1. Percentage of failures of the non-metallic posts in five studies used in systematic reviewing when compared separately in a follow-up period up to seven years.

Standlee et al.<sup>25</sup> reported that the cement layer may contribute to uniform

stress distribution between post and the root canal. Mendonza et al.<sup>26</sup> evaluated the ability of resin-bonded posts to reinforce teeth and concluded that resin cements rendered the teeth more resistant to fracture than when zinc phosphate was used.

All posts in these five studies were cemented with resin cements. 456 teeth were restored with crowns and 182 were restored with direct resin composite restorations. The table 4 shows the details of restorations used in the five studies<sup>10,12,13,16,17</sup>. In these five studies it was not possible to evaluate the quantity of failures in crowns and direct resin composite restorations separately.

## CONCLUSIONS

According to the reports of 5 studies, the hypothesis that the placement of nonmetallic posts in endodontically treated teeth is associated with improving the survival rates of restored teeth was confirmed through this systematic reviewing. The survival rates ranged from 96% at 2 years to 94% at 8 years.

Table 4. Details of the restoration types in the five studies

Reference	Position of teeth	Type of restoration	Number of Restoration	No. of Failures	Type of Failure
	Anterior	Metal-ceramic		2	Post debonding
Cagidiaco et al.	Posterior	All-ceramic Resin composite	162*	5	Post debonding
Grandini et al.	Anterior	Resin Composite	38	4	Periapical pathology
	Posterior	Composite	62	-	-
	Anterior	-	-	-	-
Monticelli et al.	Posterior	All-ceramic	225	14	Post debonding-Periapical pathology
		Metal-ceramic	11	2	Post fracture
	Anterior	All-ceramic	9	1	Post fracture
Piovesan et al.		Resin composite	16	1	Post fracture
		Metal-ceramic	18	0	-
	Posterior	All-ceramic	30	2	Post dislodgement-Post fracture
		Resin composite	25	0	-
Tuker et al.	Anterior	All-ceramic	31	0	-
	Posterior	All-ceramic	11	1	Post debonding

\*One hundred and twenty-one crowns and forty one resin composite restorations.

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