

A 3-Year Retrospective Evaluation of the Clinical Performance of Fiber Posts

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This retrospective study evaluated the clinical outcome of 139 teeth restored with carbon fiber posts after 3 years of placement, considering the amount of remaining dentin as the main variable. Eighty-one patients received the fiber posts within a period of 16 months and were recalled after 3 years. The tooth type, amount of remaining dentin, and prosthetic crown material were evaluated. No loss of post or core retention was detected after 3 years of follow up. During the observed time, root or post fracture and secondary caries were not recorded. Only one failure concerning endodontic treatment was detected. The amount of remaining dentin was not an important characteristic in the restorative failure of endodontically treated teeth restored with carbon fiber posts within 3 years.

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Introduction

The clinical behavior of restored endodontically treated teeth is influenced by several factors, including endodontic and restorative considerations (1) and the amount of remaining hard tissue (2). Coronal and root tissue loss may be caused by root canal instrumentation or increased by carious lesions, fractures or non-conservative techniques. All the mentioned causes of tissue loss may decrease the tooth resistance to fracture (3) and affect the stability and retention of the post inside the root canal, resulting in debonding (4).

The amount of remaining coronal dentin is a strong determinant of the success of endodontically treated teeth restored with fiber posts. At least 2 mm of ferrule is required for post placement (5,6). Furthermore, Mannocci et al. (7) suggested that the use of metaloceramic crowns could promote the debonding of fiber posts in consequence of the transfer of tensile and compressive stresses to the posts, causing a rupture of the adhesive interface.

This retrospective study aimed to evaluate the clinical and radiographic performance of endodontically treated teeth restored with carbon fiber posts and full crowns. The amount of remaining coronal dentin (ferrule) was the main characteristic observed over the 3-year follow-up period. The null hypothesis was that there would be no influence of the ferrule effect on the clinical success of the restored teeth during the period of investigation.

Material and Methods

Adult patients (n=81) treated within a period of 16 months (baseline condition) were initially included in this clinical retrospective study (Ethical Committee of Human Research (Process no. 061/08 - Federal University of Espírito

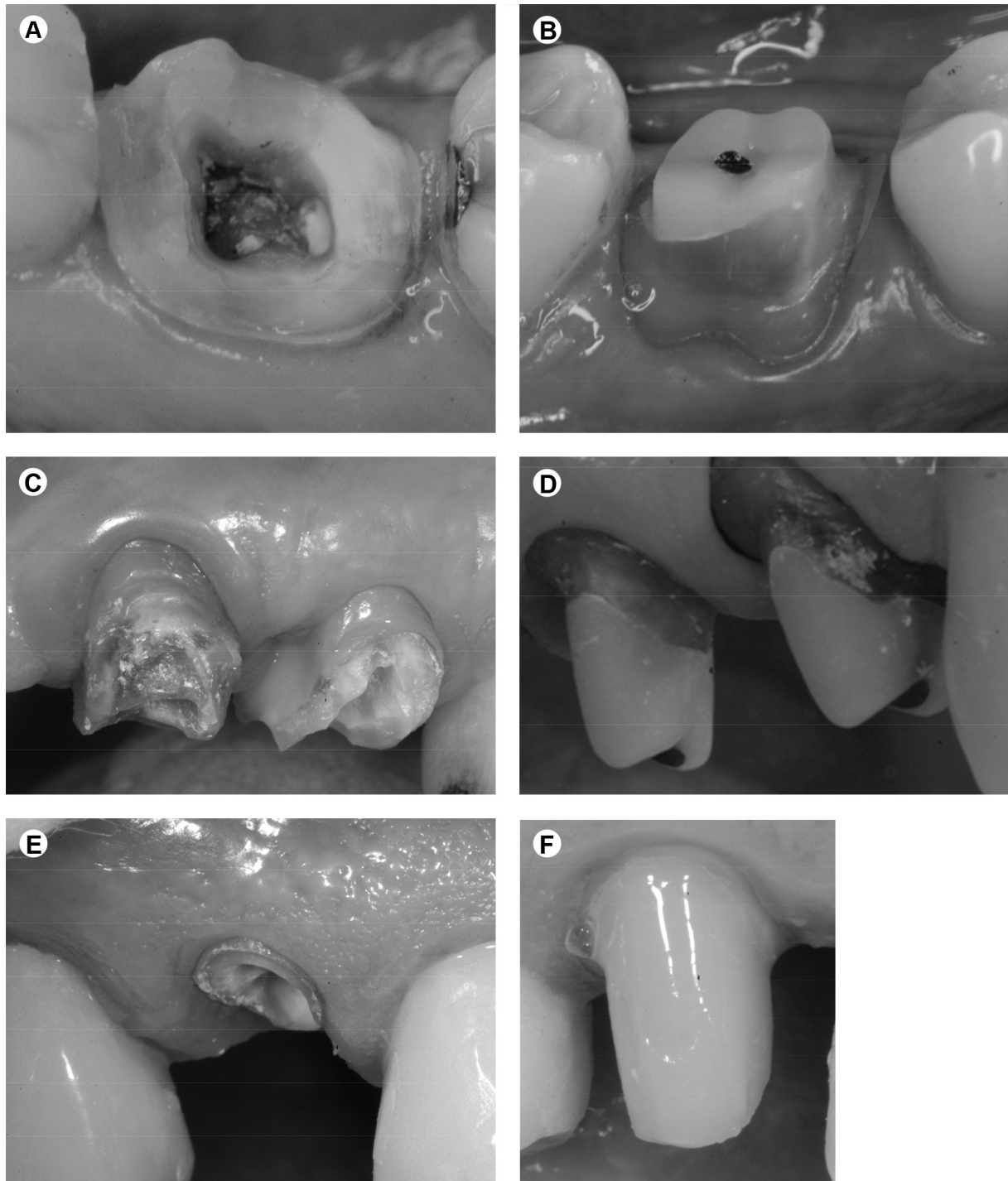
Santo). Individuals presenting one or more endodontically treated teeth restored with carbon fiber post, composite-resin core and single crown were selected and recalled after 3 years, during 7 months. From these 81 individuals, 75 subjects were chosen (total of 139 teeth) according to the following inclusion criteria: 18 years or older; under periodontal control; without partial removable dentures; with adequate occlusal contact between the restored tooth and its opponent. Patients received all the information about the research, had their doubts clarified and signed the informed consent. This study was based on STROBE guidelines.

The following data were collected and evaluated: tooth type; type of endodontic treatment performed (treatment or re-treatment); amount of remaining coronal dentin after preparation design; post type (cylindrical or tapered) and prosthetic crown material. The subjects' age and gender, the date of post and crown cementation and the restorative protocol were also collected. Since this was a retrospective study, no clinical measurement was performed at tooth preparation. The evaluation of amount of remaining dentin was performed by images from digital photographic files: pictures (buccal, occlusal and lingual sides) taken before post cementation without the temporary material (Fig. 1, left column) and after crown preparation with the post and composite core (Fig. 1, right column). The teeth were arranged in 3 groups: NF: No Ferrule: maximum amount of remaining dentin located at the gingival margin after tooth preparation (Fig. 1, top line); SF: Smaller Ferrule: maximum of remaining dentin located below the half of the preparation height after tooth preparation (Fig. 1, middle line); and LF: Large Ferrule: remaining dentin located between half or slightly more than the half of

the preparation height after tooth preparation (Fig. 1, bottom line).

The post type was selected by the endodontist based on the final geometry of the root canal and was either 2-stage cylindrical, diameters 1 and 2, (C-post®, Bisco Inc.,

Schaumburg, IL, USA), or tapered UMC-post®, ISO 90 and 100 (Bisco Inc.). The length of post cementation inside root canal was standardized by the remaining endodontic sealing from 5 to 7 mm. After 4 to 7 days of post space preparation, isolation of the field was performed with



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Figure 1. Group A (Top): maximum amount of remaining coronal dentin located at the gingival margin before (left column) and after (right column) post cementation and preparation design – no ferrule effect. Buccal view. Group B: maximum amount of remaining coronal dentin located below the half of the preparation height before (left column) and after (right column) post cementation and preparation design. Buccal view. Group C (Bottom): maximum amount of remaining coronal dentin located between half or slightly more than the half of the preparation height before (left column – lingual view) and after (right column – buccal view) post cementation and preparation design.

cotton rolls/saliva ejector and the post was cemented: canal walls were etched (37% phosphoric acid, 20 s), rinsed with water/air spray and dried with absorbent paper points. The adhesive agent (One Step[®], Bisco Inc.) was applied and photo polymerized for 60 s; the post was cemented using Hi-X[®] resin cement (Bisco Inc.). The composite core (Bis-core[®], Bisco Inc.) was reconstructed by an incremental technique (40 s of light activation per increment). The crowns were all-ceramic crowns made with feldspathic porcelain (Omega 900[®], VITA Zahnfabrik, Bad Säckingen, Bayern, Germany), alumina copings (In-Ceram[®], VITA Zahnfabrik) layered with porcelain (VM7[®], VITA Zahnfabrik) or metal-ceramic with gold-electroforming copings layered with porcelain (Omega 900[®], VITA Zahnfabrik). The crowns with alumina or gold copings were cemented using resin-modified glass ionomer cement (GC Fuji Plus[®], GC America Inc., Chicago, IL, USA); the all-ceramic crowns were cemented using dual cure resin cement (Illusion[®], Bisco Inc.) according to the manufacturer's instructions.

About three years after the post cementation date (from 36 to 41 months), all subjects were clinically examined and complementary periapical and interproximal radiographs were taken of the respective teeth. The clinical examination was performed by a single calibrated examiner. The calibration of the examiner was performed based on the concordance of two evaluations, concerning clinical, radiographic and photographic files of patients from the same private practice, who received restoration of endodontically treated teeth with quartz fiber posts associated with full crowns (intra-examiner coefficient: Kappa 0.948).

The clinical performance was assessed by the presence or absence of mechanical/biological failures, as defined: loss of adhesive retention of the post or core, vertical or horizontal root fracture, post fracture and core fracture, secondary caries and endodontic complications (classification according to the European Society of Endodontology, 2006). The tooth was considered as the experimental unit. Descriptive statistics were calculated for all teeth included in the study. Frequencies were reported as the number of cases and percentages; continuous variables were expressed as means and standard deviations.

Results

Table 1 displays the main characteristics of subjects regarding the amount of remaining dentin. Table 2 displays the distribution of teeth according to the amount of remaining dentin, tooth type, fiber post and crown system used for tooth restoration.

The follow-up period varied from 36 to 41 months. Six individuals did not fit the inclusion criteria and were excluded: three of the individuals used removable dentures,

and other three refused to participate in the research. Seventy-five subjects, aged 20–77 years (mean 51±10.3 SD), were included in this study, resulting in 139 treated teeth. Seventy-eight C-posts[®] were placed into teeth, distributed in 48 subjects and 61 UMC-posts[®] were placed into teeth, distributed in 38 participants. The sample demographic features according to the amount of remaining crown dentin (one tooth per subject) are in Table 2.

No failure was observed during the 3-year follow-up period. Details of the clinical performance are shown in Table 3. Based on the endodontic classification, 138 teeth (99.3%) were classified as favourable, without the incidence of pain, swelling or any radiographic evidence of increased periodontal width. One tooth solely (0.7%) was classified as unfavorable due to exacerbation process in the periapical lesion. The endodontic condition at baseline and after 3-year follow up is in Table 4.

Discussion

This study sought a retrospective evaluation of the clinical performance of teeth restored with carbon fiber posts and full crowns and the effect of the initial remaining amount of crown dentin. Although this study intended to test the influence of the amount of remaining dentin on the clinical performance on tooth restored with carbon fibre posts after 3 years, it was not possible to test the hypothesis, since there was only one failure. Only descriptive statistics were performed. No adhesive failures, fractures of the post or core or vertical/horizontal root fracture were observed. According to a literature review, clinical success of treatments performed with fiber posts have been reported (8). Similar results were found after 24–36 months of follow-up (6). Studies with a longer time of follow-up presented higher failure rates: 5.35% in 8 years (9) and 8% in 7–11 years (10).

Several factors are involved in the survival rate of restorative procedures in endodontically treated teeth. Each evaluated case is considered a success after the absence of negative findings at the final examination (8). The reasons

Table 1. Characteristics and distribution of the subjects within the groups

Subject characteristics	Amount of remaining coronal dentin*		
	NF (n=28)	SF (n=33)	LF (n=14)
Gender			
Male	10 (35.7%)	5 (15.1%)	4 (28.6%)
Female	18 (64.3%)	28 (84.9%)	10 (71.4%)
Age (mean±SD)	52.5 (±10.1)	52.4 (±10.2)	49.7 (±12.6)

*NF: no ferrule; SF: small ferrule; LF: large ferrule.

Table 2. Distribution of teeth according to amount of remaining dentin (NF: no ferrule; SF: small ferrule; LF: large ferrule), tooth type, fiber post and crown system

Tooth	Fiber Post	Crown restoration system	NF (n=44)	SF (n=65)	LF (n=30)
Incisors	C-Post® # 1 and 2	Feldspathic porcelain	2	2	4
		Alumina layered porcelain	3	2	0
		Electrodeposited gold layered porcelain	4	0	0
	UMC-post® # 90 and 100	Feldspathic porcelain	0	6	7
		Alumina layered porcelain	1	0	0
		Electrodeposited gold layered porcelain	0	0	0
Canines	C-Post® # 1 and 2	Feldspathic porcelain	0	1	0
		Alumina layered porcelain	4	3	0
		Electrodeposited gold layered porcelain	2	0	0
	UMC-post® # 90 e 100	Feldspathic porcelain	0	1	0
		Alumina layered porcelain	0	0	0
		Electrodeposited gold layered porcelain	1	0	0
Premolars	C-Post® # 1 and 2	Feldspathic porcelain	2	2	1
		Alumina layered porcelain	8	1	2
		Electrodeposited gold layered porcelain	1	5	0
	UMC-post® # 90 e 100	Feldspathic porcelain	0	4	2
		Alumina layered porcelain	2	4	3
		Electrodeposited gold layered porcelain	4	5	1
Molars	C-Post® # 1 and 2	Feldspathic porcelain	0	1	5
		Alumina layered porcelain	5	8	0
		Electrodeposited gold layered porcelain	4	7	0
	UMC-post® # 90 e 100	Feldspathic porcelain	1	1	3
		Alumina layered porcelain	0	4	1
		Electrodeposited gold layered porcelain	0	8	1

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Table 3. Clinical performance of restored teeth according to failure parameters

Failure parameter	Amount of remaining coronal dentin* (n=139)		
	NF	SF	LF
Total number of posts	44 (100%)	65 (100%)	30 (100%)
Post type			
C-post®	35 (7.5%)	32 (49.2%)	11 (36.7%)
UMC-post®	9 (20.5%)	33 (50.8%)	19 (63.3%)
Mechanical failures ^a	0	0	0
Biological failures	0	1 (1.5%)	0
Secondary caries	0	0	0
Endodontic complications	0	1 (1.5%)	0

*NF- no ferrule; SF- small ferrule; LF- large ferrule

Table 4. Distribution of teeth according to endodontic baseline classification and endodontic final classification (3-year recall)

Endodontic baseline classification		Endodontic final classification*
Endodontic lesion	Type of endodontic treatment	
Present (n=31)	Treatment (n=2)	Favorable healing 0.7% (n=1)
	Re-treatment (n=29)	Unfavorable healing 0.7% (n=1)
		Favorable healing 20.8% (n=29)
Absent (n=108)	Treatment (n=47)	Favorable healing 77.8% (n=108)
	Re-treatment (n=61)	

*According to the Classification of the European Society of Endodontology (35).

for failure found in the literature were endodontic problems, root fracture, fiber post fracture and post debonding (9,10). The presence of parafunctional activity was not considered as exclusion criterion because this variable is difficult to control in a retrospective study. Moreover, night bruxism is present in a large part of the population (11).

This study was performed with patients who have access to private treatment, indicative of good social condition in their country. Furthermore, patients agreed to return after 3 years for a clinical evaluation, which would result into a research report, without any financial advantage (as set by the Brazilian Ethics Committee), reflecting the instruction level of the individuals. This is a limitation to generalize for the whole population.

The results of this study demonstrate that, within a 3 year period, the supragingival amount of remaining dentin was not an important factor in the restorative failure of endodontically treated teeth restored with carbon fiber posts. The most common failure for short time evaluations are periapical lesions. The periapical condition at the baseline showed influence on the success of root canal filling after 10 years of follow up (12), with periapical lesion as a negative predictor for success of the treatment. As shown in Table 4, the tooth that presented unfavorable healing after the 3-year follow-up period presented periapical lesion at the baseline. The prognoses of survival are better for teeth that present healthy periapical conditions, treatment of previous vital teeth, favorable radiographic images of the root canal filling (i.e. homogeneously condensed and with the correct length) (12). Success of the treatment is not related to the factor treatment/retreatment (12). Additionally, failures like post debonding, tooth fracture or marginal carious lesions were also not detected in the 139 evaluated teeth.

Resumo

Este estudo avaliou de forma retrospectiva o desfecho clínico de 139 dentes restaurados com pinos de fibra de carbono após 3 anos em função, considerando a quantidade de dentina coronária remanescente como principal variável. Oitenta e um indivíduos receberam a cimentação dos pinos entre Janeiro de 2004 e Janeiro de 2005, e foram chamados para reavaliação após 3 anos. O tipo de dente restaurado, quantidade de dentina remanescente e material restaurador coronário foram avaliados. Nenhum caso de perda de retenção do pino e/ou núcleo foi encontrado durante o período de avaliação. Fraturas na raiz ou no pino e cáries secundárias também não foram registrados. Uma única falha foi encontrada em relação ao tratamento endodôntico. A quantidade de dentina remanescente não foi um fator importante para falha na restauração de dentes tratados endodonticamente, restaurados com pinos de fibra de carbono, após 3 anos de serviço clínico.

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