Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 19, issue 1, 2009, pp. 139-143

BEHAVIOUR OF ENDODONTICALLY TREATED TEETH RESTORED WITH CARBON FIBER POST SYSTEMS

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ABSTRACT. Most endodontically treated teeth require restoration with a post and core system. The present trend is to replace metallic posts by nonmetallic passive systems such as carbon fiber based ones. They were developed more than 10 years ago, but they have not been currently applied ever since. The Absolu (Spad-France) carbon fiber post and core system and the Dentatus (Svenska Dentorama AB) metallic post system were subjected to axial and angled compression loads. Two sets of monoradicular teeth were used: one of them were teeth restored with Dentatus and Polofil. The behavior of the Absolu system restoration displayed a slightly inferior resistance to fracture as compared to that of Dentatus restorations. The behavior was also influenced by the luting agent. The test values show that the former system resists well to normal occlusal loadings. The deformations occurring in the Dentatus restorations are not present in the Absolu restorations since the latter system is more rigid. The Absolu system made by bonding restorative materials to tooth structures result in monobloc restorations. The fracture of the post does not lead to root damage and therefore the root can be restored again, after removing the post by burs and solvents.

Keywords: carbon fiber systems, endodontically treated teeth, post and core restauration, prosthodontic resauration

INTRODUCTION

Statement of problem. Most endodontically treated teeth require restoration with a post and core system. The present trend is to give up on the metallic, cast or prefabricated (active, passive) posts. It is recommended to use the non-metallic, passive systems such as ceramics and carbon fiber based ones. They were developed more than ten years ago, but they have not been currently applied ever since.

Purpose. This study presents two (out of a lot of 16) clinical cases in which the restoring of endodontically treated teeth was made with an Absolu (Spad – France) carbon fiber post and core system. The in vitro behavior under axial and angled compression loads, of the carbon fiber based posts and core system was compared to that of the Dentatus metallic post system (Svenska Dentorama AB) which is widely used in Romania for restoring endodontically treated teeth.

MATERIALS AND METHODS

16 patients with damaged and endodontically treated monoradicular teeth were treated. The restoration of these teeth was performed with an Absolu carbon fiber-based post and core system, luted with Panavia EX and Cetac-Cem. The cores were restored with Polofil (Voco) composite resin.

No failures appeared during an observation period of two years.

For the in vitro study 42 monoradicular teeth of similar dimension were used. They were recently extracted and stored in saline solution during the experiment.

The coronal parts of the teeth were removed 2 mm above the anatomic dental neck. In order to avoid the contamination of the luting material, the teeth were not endodontically filled. Specimens were restored, then mounted in polymeric resin blocs and divided in seven groups as follows:

- Group 1: 6 teeth restored with Dentatus post and core systems, luted with zinc-phosphate cement and core built up with Polofil hybrid composite resin.
- Group 2: 6 teeth restored with Dentatus, luted with glass ionomer cement and core built up with Polofil hybrid composite resin
- Group 3: 6 teeth restored with Dentatus, luted with resin cement (Panavia EX) and core of Polofil.
- Group 4: 6 teeth restored with Absolu carbon fiber-based post and core system, luted with zinc-phosphate cement and core of Polofil.
- Group 5: 6 teeth restored with Absolu system, luted with glass ionomer cement and core of Polofil
- Group 6: 6 teeth restored with Absolu system, luted with resin cement (TWINLOK) and solid bond P+S and core of Polofil
- Group 7: 6 teeth restored with Absolu system, luted with resin cement (Panavia EX) and core of Polofil

Twenty-four hours after the restoration, the specimens were subjected to axial compression loads at an angle of 30º by a testing machine until the first signs of failure appeared (cracks and fractures).

The average results obtained for each group are shown in Tables 1-9.

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Article received: october 2008; published: march 2009

RESULTS AND DISCUSSIONS

Tabel 1

	DENTATUS + FOZ	DENTATUS + CIS	DENTATUS + PANAVIA
Axel compression	400N	300N	600N
Angled compression	300N	200N	410N
Tensile load	234N	380N	370N

Table 2

Vertical stress		
Specimen	**Load**	**Deformation**
Carbon + PANAVIA	0N	0 mm
Carbon + PANAVIA	100N	0,18mm
Carbon + PANAVIA	150N	0,25mm
Carbon + PANAVIA	200N	0,31mm
Carbon + PANAVIA	250N	0,37mm
Carbon + PANAVIA	300N	0,42mm
Carbon + PANAVIA	350N	0,49mm
Carbon + PANAVIA	400N	0,55mm
Carbon + PANAVIA	450N	0,62mm
Carbon + PANAVIA	500N	0,72mm
Carbon + PANAVIA	530N	0,75mm
Carbon + PANAVIA	550N	0,78mm

Table 3

Oblique stress		
Specimen	**Load**	**Deformation**
Carbon + PANAVIA	300N	0,41mm
Carbon + PANAVIA	500N	0,49mm
Carbon + PANAVIA	600N	0,52mm
Carbon + PANAVIA	700N	0,55mm
Carbon + PANAVIA	800N	0,59mm
Carbon + PANAVIA	900N	0,62mm
Carbon + PANAVIA	1000N	0,66mm
Carbon + PANAVIA	1500N	Specimen
Carbon + PANAVIA	1600N	destroyed

Table 4

Vertical stress		
Specimen	**Load**	**Deformation**
Carbon + TWINLOCK	0N	0mm
Carbon + TWINLOCK	100N	0,14mm
Carbon + TWINLOCK	150N	0,19mm
Carbon + TWINLOCK	200N	0,23mm
Carbon + TWINLOCK	230N	0,25mm
Carbon + TWINLOCK	250N	0,28mm
Carbon + TWINLOCK	280N	0,30mm
Carbon + TWINLOCK	300N	0,32mm
Carbon + TWINLOCK	350N	0,37mm
Carbon + TWINLOCK	400N	0,41mm
Carbon + TWINLOCK	450N	0,45mm
Carbon + TWINLOCK	500N	0,50mm

Table 5

Oblique stress		
Specimen	**Load**	**Deformation**
Carbon + TWINLOCK	250N	0,23mm
Carbon + TWINLOCK	500N	0,35mm
Carbon + TWINLOCK	750N	0,42mm
Carbon + TWINLOCK	1000N	0,50mm
Carbon + TWINLOCK	1250N	0,62mm
Carbon + TWINLOCK	1500N	0,70mm
Carbon + TWINLOCK	1600N	0,76mm
Carbon + TWINLOCK	1750N	0,84mm

The clinical study after 2 years shows no failure. The compression tests point out great loads to which signs of failure appeared.

In contrast to the restorations with Dentatus, the teeth restored with carbon fiber post and cores exhibited slightly inferior strength as a result of the material and the luting technique which were used.

The strength is lower when using glass ionomer cement but it increases when using a bonding resin on the post and core or on the dentin.

When using resin cements the results are better with Panavia EX than with Twinlock, and similar to those obtained in restorations with Dentatus and the same cement.

In all groups the Absolu system is more rigid than the metallic system. There was only one macroscopic failure of the composite resin built up core and one root fracture near the dental neck.

In the other specimens it seems that the machine did not record the first internal cracks which could have been identified only under a microscope.

The obtained values show that the post and core system resists to normal occlusal loads.

The final restoration will enhance the resistance of the whole ensamble.

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Table 6

Vertical stress		
Specimen	**Load**	**Deformation**
Carbon+CIS	0N	0mm
Carbon+CIS	100N	0,15mm
Carbon+CIS	150N	0,23mm
Carbon+CIS	200N	0,28mm
Carbon+CIS	250N	0,31mm
Carbon+CIS	300N	0,35mm
Carbon+CIS	350N	0,40mm
Carbon+CIS	400N	0,45mm
Carbon+CIS	450N	0,49mm
Carbon+CIS	500N	0,54mm

Table 7

Oblique stress		
Specimen	**Load**	**Deformation**
Carbon+CIS	500N	0,38mm
Carbon+CIS	750N	0,50mm
Carbon+CIS	1000N	0,60mm
Carbon+CIS	1250N	0,71mm
Carbon+CIS	1500N	0,78mm
Carbon+CIS	1750N	0,89mm
Carbon+CIS	2000N	0,98mm

Table 8

Vertical stress		
Specimen	**Load**	**Deformation**
Carbon+CIS+solid bond S	0N	0mm
Carbon+CIS+solid bond S	100N	0,17mm
Carbon+CIS+solid bond S	150N	0,24mm
Carbon+CIS+solid bond S	200N	0,27mm
Carbon+CIS+solid bond S	250N	0,32mm
Carbon+CIS+solid bond S	300N	0,37mm
Carbon+CIS+solid bond S	350N	0,42mm
Carbon+CIS+solid bond S	400N	0,46mm
Carbon+CIS+solid bond S	450N	0,50mm
Carbon+CIS+solid bond S	500N	0,54mm

Table 9

Oblique stress		
Specimen	**Load**	**Deformation**
Carbon+CIS+solid bond S	500N	0,43mm
Carbon+CIS+solid bond S	750N	0,54mm
Carbon+CIS+solid bond S	1000N	0,64mm
Carbon+CIS+solid bond S	1250N	0,74mm
Carbon+CIS+solid bond S	1500N	0,84mm
Carbon+CIS+solid bond S	1750N	0,97mm
Carbon+CIS+solid bond S	2000N	1,11mm

CONCLUSIONS

The restoration of endodontically treated teeth with carbon fiber-based post and core system is an easy one-step procedure and does not require laboratory assistance.

The root canal preparation is conservative

The intra-radicular aggregation of the post is obtained by bonding

The aggregation is passive

The four components (dental tissue, radicular post, composite resin and composite cement) make a homogeneous monoblock with good mechanical properties (resistance to compression, tensile load and torque) and elasticity similar to that of the dentin.

The post and core system must support the material used for coronal restoration, absorb and distribute uniformly the functional and the para-functional forces, thus reducing the risk of fracture.

It exhibits stability and longevity because of it's good mechanical properties. It is not exposed to any risk of corrosion. The fractures occurred allow for a new dental restoration.

In case of failure the removing of the post can be easily made with rotary instruments and solvents.

The system is not compatible with "Eugenol" based root canal fillings.

Based on the present clinical tests it is not possible to assess the biodegradability and the tightness of the system just by clinical recalls.

Fig. 1 "ABSOLU" Carbon fiber based post and core system

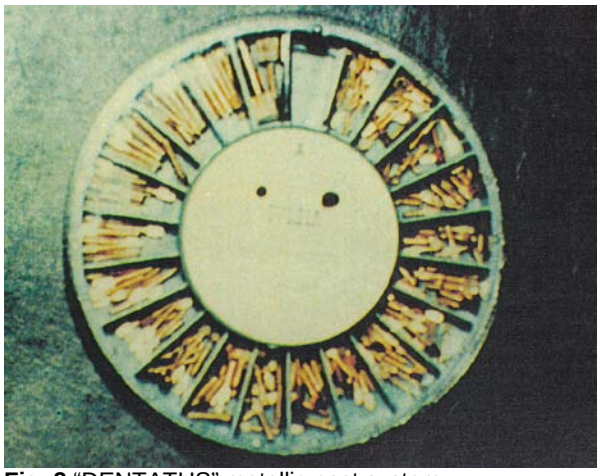

Fig. 2 "DENTATUS" metallic post system

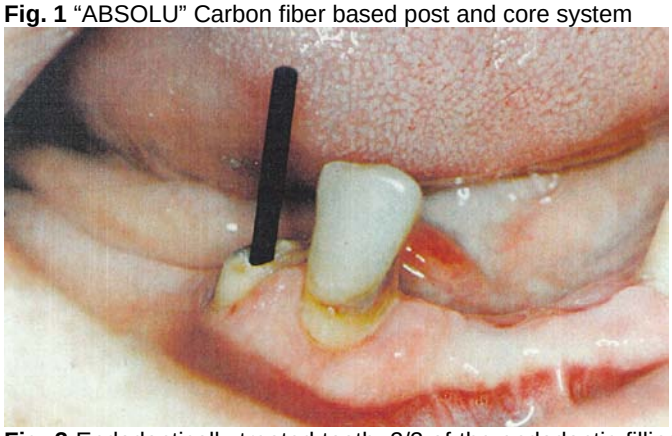

Fig. 3 Endodontically treated tooth, 2/3 of the endodontic filling is removed with the Absolu system burs. Try-in of the carbon fiber post on the abutment.

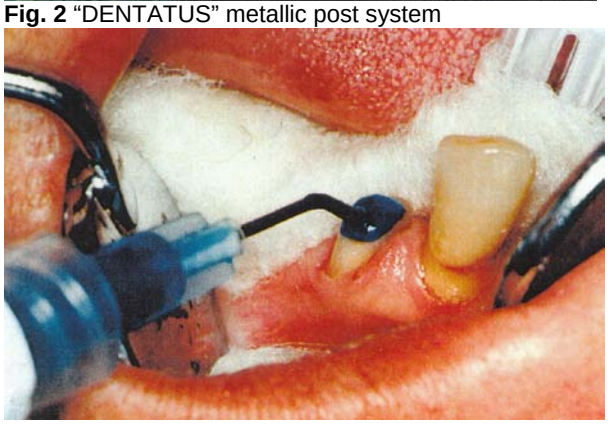

Fig. 4 Conditioning of the root cavity dentin with phosphoric acid gel.

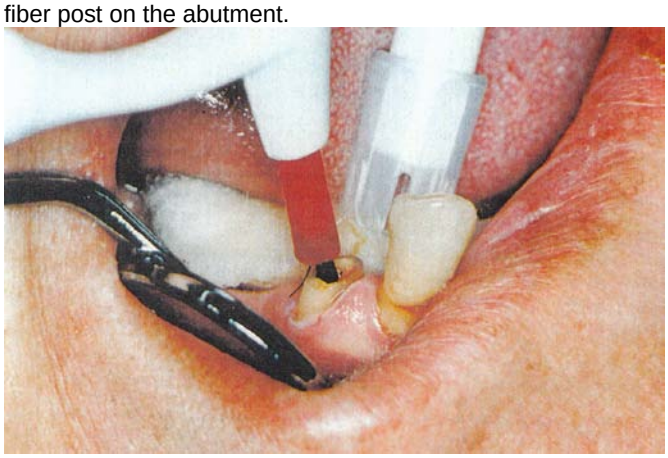

Fig. 5 After rinsing and drying the root canal cavity a dentin bonding agent is applied

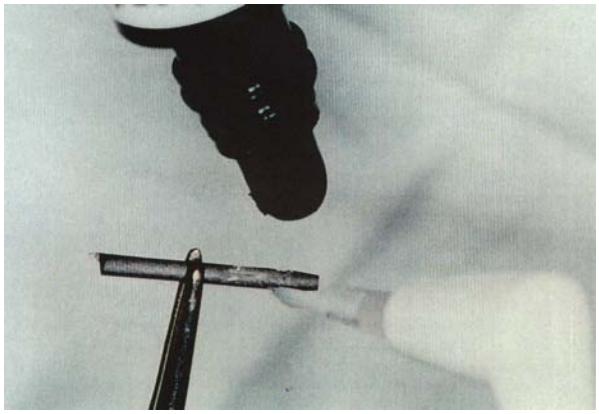

Fig. 6 A bonding agent is also applied to the post

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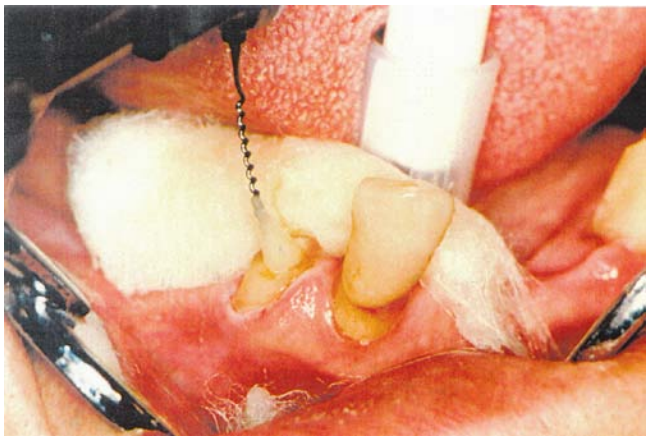

Fig. 7 Application of the bonding resin

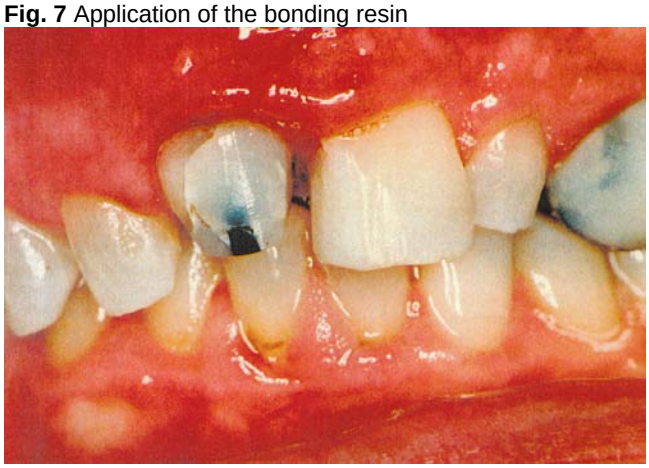

Fig. 8 Final abutment preparation, Tooth 11 restored in the same manner

REFERENCES

Andreescu C., Cherla V., Tehnica restaurărilor coronare cu ajutorul pivoturilor parapulpare şi intraradiculare, Ed. Cerna Bucureşti 1999

Bratu D., Fabricky M., Sisteme integral ceramic, Ed. Helicon Timişoara, 1999

Bratu D. et al., Materiale dentare, Vol I-II Ed. Helicon Timişoara 1994

Cohen M., Interdisciplinary treatment planning Principles, Design and Implementation, Quintessence Publishing Co, Inc. 2008

Combe E., Notes on detal material. Sixth edition, Curchill Livingstone, 1992

Faraneh M, Abitbol S, Friedman S., Treatment outcome in endodontics: The Toronto study. Phases I and II: Orthograde Retreatment. J Endod 2004; 30, pp. 627-633

Giordano R.A., Dental Ceramc restuartive systems, Compendium, Vol 17, No. 8, 1997

Haller B., Bischo F.H., Metallfreie Restaurationen aus Presskeramik, Quintesseny, Berlin 1993

Hoffmann N., Preparation and insertion of computer – designed ceramic inlays, Die Herstellung und Eingliederung von coputersgefrosten Keramik Inlays ZWR Jub, 99(7), p. 530-7, 1990

Kappert H.F., Dental Materials, new ceramic systems, Academy of Dental Materials, p. 18-198, 1996

Knellesen C., Degrange M., Les inlays en vitroceramique vers une nouvelle dentistrie restauratice – Cah. Prothese 1987; 60: pp. 149-162

Krejci I., Krejci D., Lutz F., Clinical evaluation of a new pressed glassceramic inlay material over 15 years. Quintessence Int. 23: pp. 181-186, 1992

McClean J.W., Science and Art of Dental Ceramics, vol. I, The nature of Dental Ceramics and their Clinical use. Quintessence, Chicago 1979

Morman W.H., Brandstini M., Lutz F., Barakow F., Inlays et onlays en ceramiquie: fabrication assitee par ordinator, Clinic/Odontologia 1992, 1: pp.55-56

Nussbaum R., Afecţiunile coronare ale dinţilor şi tratamentul protetic. Microproteze. Lito IMT 1986

Reich E., Schmalz G., Federlein M., Randsaltnerhalten von Keramik – und Komositinlays in vitro. Dtsch. Zahnarztl. Z., pp. 656-600, 1990.

Sadoun M. Degrange M., Les ceramiques dentaires, 2e partie – J. Bionat., Dent., 1986, 3: pp.215-225

Seghi R.R., Denry J.L., Rosenstiel S.F., Relative fracture thoughness and hardness of new dental ceramics, Journal of Dental Prosthetics 74, pp.145-150, 1995

Wahner W.C., Chu T.M., Biaxial flexural strength and indentation fracture toughness of three new dental core ceramics – J. Prosth. Dent. Aug 76 (2) p140 – 144, 1996.

West J., Collaborative endodontic techniques: A comprehensive clinical review. Dent Collab Spring 2004:pp.21-28

West J., Endodontic update 2006. J Esthet Restorative Dent 2006; 18:pp.280-300

West J.D., The cracked tooth syndrome. Dent Today 2002; 21, pp.88-97

Wohlwend A., Strub J.R., Scharer P., Metal ceramic and all porcelain restorations, J. Prosth. Dent., 1990, 2:pp.13-26