P85

Pages 85 - 90

Restorative Case Report: Flexibility of Fibre-Posts

ABSTRACT

Restoration of an anterior root-filled tooth with little remaining coronal tooth-tissue can utilise a post to retain a core, enabling definitive restoration. Post material was, until recently, primarily metal - be it cast or prefabricated. Currently, fibre-posts are promoted as being advantageous due to a favourable failure mechanism which may protect the root from fracture. This Case Report demonstrates failure of the structural integrity of a fibre-post in a maxillary lateral incisor, with a proposed explanation. Retreatment employed a diamond-coated ultrasonic tip for removal of the residual fibre-post and restoration with a cast-post and metal ceramic crown.

Keywords

Fibre-post

Authors

Paula E Lancaster *

(BChD, DGDP RCSEng, MDentSci, MFDS RCSEd)

Address for Correspondence

Paula E Lancaster *

Email: p.e.lancaster@leeds.ac.uk

* *Level 6 Worsley Building*
Clarendon Way
Leeds
West Yorkshire
LS2 9LU

INTRODUCTION

Root-filled teeth can have varying degrees of remaining tooth-tissue and an intra-radicular post may be utilised to retain a definitive restoration. There are many tooth and post factors to consider when prescribing posts *(Table 1)*, with risks such as: root-fracture, perforation and disturbance of the apical seal during preparation. Failure mechanisms include tooth-fracture, post-fracture and loss of post-retention.

Cast-posts were traditionally used but require impressions, an additional visit for laboratory-production and associated cost, with the need for a temporary restoration increasing the likelihood of coronal leakage.[1]

Prefabricated-posts can be placed immediately following obturation of the root canal, with a range of materials being available, e.g., stainless steel, titanium, zirconium and fibre-posts which consist of a resin matrix (epoxy or methacrylate) and carbon, quartz, glass (E and S) or polyethylene fibres[2] *(Figure 1)*.

Fibre-posts are promoted as aesthetic, metal-free and with mechanical properties claimed to be similar to that of dentine which reduce the risk of root-fracture, with an improved prospect of retreatment.[2] Care is needed interpreting such claims which can be misleading, especially with respect to comparison with dentine. The modulus of elasticity of dentine has a range of values from 10 to 30GPa (mean 13.2 ±4 GPa)[3], depending on the assessment method and sample. It must be remembered dentine is not homogenous, with changing characteristics from location-to-location and age. The flexural modulus of dentine has been cited with a mean value of 17.5 ±3.8GPa, which overlaps that cited for the modulus of elasticity.[4] Comparison of the flexural modulus of dentine with that of metal-posts (i.e., stainless steel, titanium and gold) show metal-posts to be of the order of 4 to 10 times higher than dentine. Carbon fibre-posts can fall within the same range as metal-posts, with up to 7 times the value of dentine. Glass fibre-posts do have the closest values to dentine of the available posts, but their values are still up to 3 times higher.[5,6]

Received: 21.10.2014
Accepted: 15.04.2015
doi: 10.1922/EJPRD_1414Lancaster06

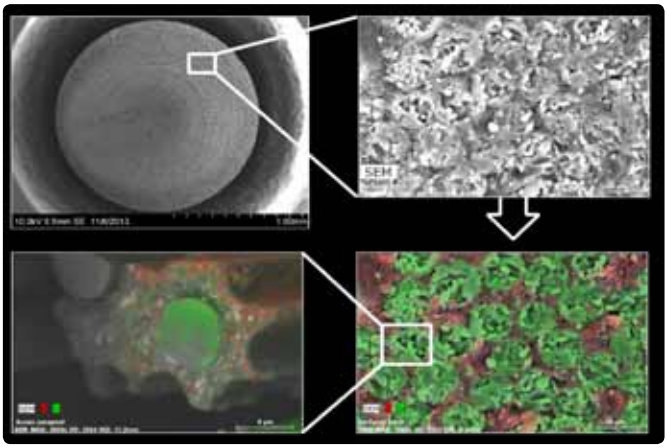

Figure 1: Scanning Electron Microscope Image and Elemental Map (Courtesy of Jackie Hudson, Oral Biology Dept, University of Leeds – Hitachi S3400N Variable Pressure Scanning Electron Microscope and Elemental Map from Brooker Quantax 129eV EDS Detector with Associated Software) of a new Fibre Lux ParaPost shows an ordered cohesive structure with the silicon fibres (green) being surrounded with a carbon-based matrix (red).

In-vivo evidence is limited for fibre-posts but a randomized Control Study of 200 teeth over 3.8 years demonstrated no root-fractures from epoxy resin fibre-posts (Composipost), but 9% (9/98) of cast-metal-posts sustained root-fracture.[7]

Conversely, in a prospective clinical study with mean duration of 7.25 years, survival rates for carbon fibre-reinforced-posts have been shown to be 71% (10/14) compared to 89% (8/9) for a wrought precious alloy.[8]

A 3-Year Randomized Control Study compared cast-metal-posts with glass fibre-posts and demonstrated the type of post did not significantly influence the survival rate of the restoration.[9]

Sample-sizes vary considerably in these Studies and they do not always present sample-size calculations, inclusion criteria of the subjects, or take into account some confounders, e.g., age and tooth-type. Omission of crucial information relating to the extent of remaining tooth-tissue and post diameter or length, along with failure to disclose whether single or multiple operators led the trial, questions the extent of bias within the Studies and makes true comparison difficult.

A Systematic Review of Clinical Studies, with at least five years' follow-up, has reported the incidence of root-fracture between metal-posts and fibre-reinforced-posts, and showed a survival rate of 90% (95% CI = 85.5-93.3%) and 83.9% (95% CI = 67.6-92.8%), respectively. Root-fractures from carbon fibre and prefabricated metal-posts, with disastrous consequences, had a 2-fold increase compared to cast- metal-posts and glass-fibre-posts which contradicts in-vitro Studies, indicating cast-posts are more prone to such failure.[10]

In-vitro evidence needs to be viewed cautiously, as this assumes that human tooth-tissue and fibre-posts behave the same in the laboratory as in the mouth. Fibre-posts are anisotropic (rather than isotropic like metal-posts) and the mecha-

Table 1: Factors to consider when prescribing a post

Tooth	Post
Position in the mouth: • anterior teeth (incisors and v canines) versus posterior teeth • maxillary teeth versus mandibular	Shape of post: • oval • round • parallel • tapered • anatomical • vented
Amount of remaining coronal tooth- tissue with the presence or absence of a ferrule.	Diameter: • too narrow - post fractures • too wide - risk of root fracture
Radiographic: • remaining root-length and thickness • quality of obturation and material • radicular pathology • alveolar bone-level	Length: • too long - risks perforation • too short - poor retention
Periodontal support	Cement-type and thickness
Endodontic status: • percussion • palpation • presence of sinus • probing-depth • mobility	Material: • carbon-fibre • fibre-glass • quartz-fibre • silica • zirconium • titanium • polyethylene
Surface preparation and treatment prior to post-placement	Surface preparation and treatment prior to placement
Proximal contacts increase success	
Occlusal contacts and para-functional habits	

nism of failure may vary depending on the direction of load, e.g., the fibre may de-bond from the matrix, the matrix may crack or the fibre itself may break.[11] The rigidity of the post has been cited to influence marginal leakage, with an increase in micro-leakage from more flexible fibre-posts compared to metal - this being most evident on the palatal aspect, even in the presence of a ferrule.[12] Metal-posts are more resistant to fracture than fibre-posts.[13,14] Opinions vary on the importance of the presence of a ferrule - with claims that it is an essential requirement which reduces the risk of fracture,[15,16] to there being no significant difference.[17,18]

Degradation of a fibre-post can occur due to water-absorption reducing its flexural strength[19] and may be due to failure of the coronal bond or micro-leakage, ultimately leading to failure of the fibre-post.

Care also needs to be exercised when adjusting a post coronally prior to placement, as this can lead to separation of the fibres from the matrix and the use of water is recommended when using a diamond bur.[20]

Currently, there are no clear guidelines or selection criteria for posts[21] and clinicians base their decisions on experience rather than validated evidence. This Case Report presents one problem encountered with a fibre-post.

CLINICAL REPORT

A retired 63 year-old female presented complaining of mobility from the upper-right-lateral incisor crown (12). This had become progressively worse over the preceding four weeks without pain or discomfort but eating was becoming more difficult.

The crown had been placed 4 years previously on a fibre-post [Fibre Lux ParaPost – red, diameter 1.25mm] retained composite-core.

Medically, the patient was well, taking prescribed medication of ranitidine hydrochloride 150mg twice-daily for acid reflux.

On examination, extra-oral and intra-oral soft tissues were of normal appearance. Oral hygiene was good with minimal plaque deposits and healthy gingival tissue. The dentition was heavily restored in a Skeletal Class I with mild Class III incisal relationship and lateral excursion being guided in group-function.

The metal ceramic crown on the 12 was mobile in the labial-palatal planes but not vertically. There was an unusual feel to the movement. Unlike loose crowns, there was no vertical movement and there was a rubbery, elastic bending sensation on the application of pressure labially and palatally.

A periapical radiograph *(Figure 2)*, showed an acceptable root-filling in the tooth and a fibre-post seating against the gutta percha with no apical pathology and good alveolar bone-levels. A radiolucent area was evident beneath the crown.

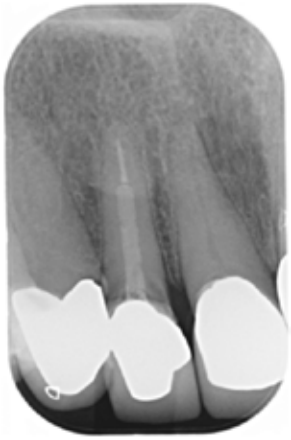

Figure 2: Periapical Radiograph of Upper-Right-Lateral Incisor.

The crown was displaced easily with application of vertical force via an excavator and the composite-core was intact. Debris was evident on the neck of the tooth. Application of pressure buccally and palatally bent the intact core on the post in the equivalent direction *(Figure 3)*.

Figure 3: Intact-core and buccal displacement of fibre-post on application of pressure.

The fibre-post and core were detached, leaving the apical portion securely cemented within the root *(Figure 4)*.

Figure 4: Apical portion of fibre-post retained in intact-root and detached coronal portion with composite-core.

Very little coronal tissue remained, with none for a ferrule. No root-fracture was evident and the tooth was of aesthetic value, receiving little occlusal loading in lateral excursion.

Treatment options were discussed *(Table 2)* and re-treatment of the tooth was undertaken, with removal of the remaining fibre-post with the aid of magnification, e.g., loupes and a microscope, and a diamond-coated ultra-sonic tip [CT4].

A seal was placed over the gutta-percha [Vitrebond] and an addition cure silicone impression [Kerr Extrude Extra Heavy and Light Body] was taken with an impression-post [Parapost] for production of a cast-post and core. The tooth was restored with a chairside temporary-crown [Integrity®], a temporary-post [Parapost] and cement [Temp Bond].

The cast-post [Dentalor®60] was cemented with an adhesive cement [Panavia 21™], followed by a further silicone impression with gingival retraction-cord [Ultrapak]. A laboratory temporary-crown restored aesthetics and function in the interim and was succeeded by a metal ceramic crown *(Figure 5)*.

Figure 5: Cast-post with definitive metal ceramic crown in-situ.

Table 2: Treatment options for the Upper-Right-Lateral Incisor

Treatment Options
Do nothing
Extract the root, followed by: • a removable prosthesis, e.g., acrylic partial-denture and a cobalt-chrome, following healing • a fixed-prosthesis, e.g., immediate temporary-bridge and definitive conventional bridge, following healing • an implant-retained crown
Retain the root with the post in-situ and utilise as an over-denture-abutment for a removable prosthesis, e.g., acrylic or cobalt-chrome
Retain the root and remove the post, followed by: • orthodontic extrusion to provide tissue to act as a ferrule • crown-lengthening to provide tissue to act as a ferrule • nil and accept no tissue for a ferrule and restore with a: • prefabricated-post, e.g., fibre-post, Zirconia-post, Titanium- or Steel-post • Cast-metal-post followed by an appropriate crown: • metal ceramic crown • all-ceramic crown.

DISCUSSION

The fibre-post had failed, with loss of structural integrity at the level of the cervical margin resulting in flexibility of the post and associated mobility of the crown. As seen from the SEM *(Figure 6)*, the fibres of the post are in total disarray compared to the new post *(Figure 1)*, with bent, broken fibres facing multiple directions with separation from the matrix.

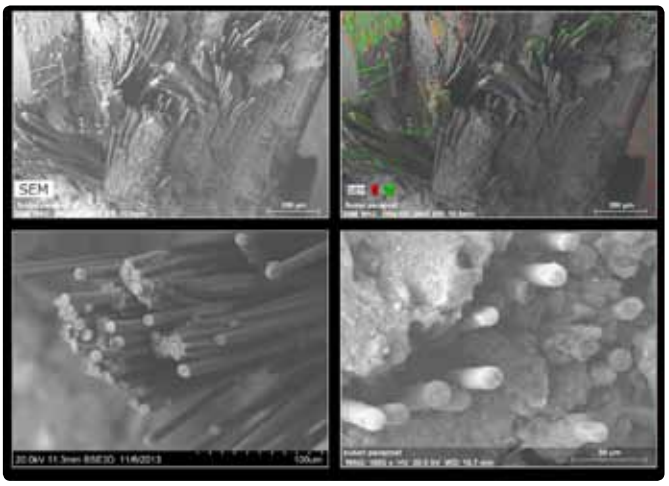

Figure 6: Disordered structure of detached coronal portion of fibre-post, showing separation of fibres from the matrix, and broken fibres.

There had been no failure of the bond between the root-dentine and post, and the core was retained coronally to the post, nor had the root fractured. This tooth had no ferrule, which may have allowed increased mechanical movement of the crown on the root, leading to micro-leakage. This continuous contamination of the post could lead to degeneration and loss of structural integrity. A cast-post may have the advantage over the fibre-post in this situation, being more rigid. There was no desire to crown-lengthen the tooth as aesthetics would be compromised and the Patient did not want orthodontic extrusion to enable creation for a ferrule.

Physical properties of fibre-posts appear good in the literature but are often laboratory-based, which cannot truly reproduce the oral environment with respect to masticatory forces and micro-leakage. This lady had acid reflux controlled by medication, but is the oral fluid the teeth reside in compounding the detrimental effect of micro-leakage on the integrity of the post?

The diameter of any post is a compromise between retaining adequate dentine- thickness of the root (1 mm minimum) and sufficient thickness of the post, to prevent fracture of either. The lateral-incisor is one of the smallest teeth of the adult dentition and a post diameter of 1.25 mm was achieved. There were no parafunctional habits reported, with a favourable occlusion. The direction of the masticatory forces can be very variable and, over the years, a diameter of 1.25 mm may be insufficient from a fibre-post to withstand this, compared to a cast-post.

A diamond-coated ultrasonic-tip removed the post without great loss of remaining tooth-tissue but was time consuming. Alternatives are available,[22] e.g., post-pullers and Masseran Kits. Care needs to be exercised to avoid root-perforation or fracture.

Following discussion with this Patient, re-treatment involved the use of a cast-post and core with a metal ceramic crown, with the aim of reducing the flexure of the post. This method had provided a successful prosthesis for 18 years prior to placement of the fibre-post. The original cast-post was replaced due to loss of retention from cement failure.

SUMMARY

The cast-post should not be lost from our armamentarium and is still a viable option, especially for: large canals, oval canals and diaphragms. In-vivo evidence is limited for the pros-and-cons of fibre-post versus cast-post. In-vitro Studies produce data for our consumption, influencing clinical decisions, but are they truly comparable to the oral environment of our patients?

Correctly designed Randomized Control Studies with sufficient power and duration are needed.

This fibre-post had failed within 4 years, compared to 18 years for a cast-post. The position and oral environment are the same for each and both restored with a metal ceramic crown, but with an additional 14 years longevity achieved from a cast-post. Could this be due to the rigidity of the post and associated benefits? This lady requested a cast-post from previous experience and accepted the risk of root-fracture.

ACKNOWLEDGEMENTS:

The Author thanks Jackie Hudson for producing the SEM and Elemental Images of the Fibre-Post

MANUFACTURERS' DETAILS:

- Fibre Lux ParaPost, Impression Post and Temporary Post, Coltene – www.coltene.com
- Integrity® Temporary Crown and Bridge Material, Dentsply – www.dentsply.com
- Extrude Extra Heavy and Light Body Silicone Impression Material – www.kerrdental.com
- Temp Bond Temporary Dental Cement, Kerr Dental – www.kerrdental.com
- Panavia 21™, Kuraray Dental – www.kuraraydental.com
- Ultrapak Knitted Retraction Cord, Optident – www.optident.co.uk
- CT4 Diamond-Coated Ultra-sonic Tips, SybronEndo – www.sybronendo.com
- Vitrebond Plus Light Cure Glass Ionomer Liner/Base, 3M ESPE – www.3m.co.uk
- Dentalor®60, Cendres+Métaux – www.cmsa.ch/dental

REFERENCES

1. Fox K, Gutteridge DL. An In-vitro Study of Coronal Microleakage in Root-canal-treated Teeth Restored by the Post and Core Technique. *Int Endo J* 1997;**30**(6):361-8.
2. Lamichhane A, Xu C, Zhang F-q. Dental Fibre-post Resin Base Material: A Review. *J Adv Prosthodont.* 2014;**6**:60-5.
3. Kinney JH, Marshall SJ, Marshall GW. The Mechanical Properties of Human Enamel and Dentine Using an Indentation Technique. *Arch Oral Biol* 2003;**41**(6):539-45.
4. Plotino G, Grande NM, Bedini R, Pameijer CH, Somma F. Flexural Properties of Endodontic Posts and Human Root Dentine. *Dent Materials* 2007;**23**:1129-35.
5. Stewardson DA, Shortall AC, Marquis PM, Lumley PJ. The Flexural Properties of Endodontic Post Materials. *Dent Materials* 2010;**26**:730-36.
6. Stewardson DA, Shortall AC, Marquis PM. The Effect of the Elastic Modulus of Endodontic Posts on Static Load Failure. *Int Endo J* 2011;**44**:458-68.
7. Ferrari M, Vichi A, García-Godoy F. Clinical Evaluation of Fiber-reinforced Epoxy Resin Posts and Cast Post and Cores. *Am J Dent* 2000;**13**:15B-18B.
8. King PA, Setchell DJ, Rees JS. Clinical Evaluation of a Carbon Fibre Reinforced Carbon Endodontic Post. *J Oral Rehab* 2003;**30**:785-89.
9. Sarkis-Onofre R, Jacinto Rde C, Boscato N, Cenci MS, Pereira-Cenci T. Cast Metal versus Glass Fibre Posts: A Randomized Controlled Trial with up to 3 Years of Follow-up. *J Dent* 2014;**42**(5):582-7.
10. Figueiredo FE, Martins-Filho PR, Faria-E-Silva AL. Do Metal Post-retained Restorations Result in More Root Fractures than Fibre Post-retained Restorations? A Systematic Review and Meta-analysis. *J Endo* 2015;**41**(3):309-16.
11. Chieruzzi M, Pagano S, Pennacchi M, Lombardo G, D'Errico P, Kenny JM. Compressive and Flexural Behaviour of Fibre Reinforced Endodontic Posts. J Dent 2012;**40**:968-78.
12. Chang JWW, Soo I, Cheung GSP. Evaluation of Fibre Post-Supported Restorations Under Simulated Occlusal Loading. J Pros Dent 2012;**108**:158-64.
13. Makade CS, Meshram GK, Warhadpande M, Patil PG. A Comparative Evaluation of Fracture Resistance of Endodontically Treated Teeth Restored with Different Post Core Systems - An In-vitro Study. J Adv Prosthodont. 2011;**3**(2):90-5.
14. Al-Wahadni AM, Hamdan S, Al-Omiri M, Hammad MM, Hatamleh MM. Fracture Resistance of Teeth Restored with Different Post Systems: In-vitro Study. Oral Surg Oral Med Oral Path Oral Radiol Endod 2008;**106**(2):e77-83.
15. Naumann M, Reich S, Nothdurft F, Dietrich T. Survival of Glass Fibre Post Restorations Over 5 Years. Am J Dent 2008;**21**:267-72.
16. Juloski J, Radovic I, Goracci C, Vulicevic ZR, Ferrari M. Ferrule Effect: A Literature Review. J Endo 2012;**38**(1):11-9.
17. Fragou T, Tortopidis D, Kontonaski E, Evangelinaki E, Ioannidis K, Petridis H, *et al*. The Effect of Ferrule on the Fracture Mode of Endodontically Treated Canines Restored with Fibre Posts and Metal Ceramic or All Ceramic Crowns. J Dent 2012;**40**:276-85.
18. Gegauff AG. Effect of Crown Lengthening and Ferrule Placement on Static Load Failure of Cemented Cast Post-cores and Crowns. J Pros Dent 2000;**84**:169-79.
19. Mannocci F, Sherriff M, Watson TF. Three-point Bending Test of Fibre Posts. J Endo 2001;**27**(12):758-61.
20. Hird CJ. A Comparison of Hand-cutting Techniques for the Chairside Adjustment of Glass Fibre Reinforced Composite Posts. [MSc]. Leeds, UK, 2013.
21. Bolla M, Muller-Bolla M, Borg C, Lupi-Pegurier L, Laplanche O, Leforestier E. Root Canal Posts for the Restoration of Root Filled Teeth. Cochrane Database of Systematic Reviews 2007;**1**(CD004623).
22. Rollings S, Stevenson B, Ricketts D. Posts - When It All Goes Wrong! Part 2: Post Removal Techniques. Dent Update 2013;**40**:166-7