Journal of Oral Science, Vol. 49, No. 2, 179-182, 2007

Case Report

Application of a pre-impregnated fiber-reinforced composite in the fabrication of an indirect dowel-core

Naomi Tanoue[1)], Kiyoshi Nagano[2)], Hideaki Shiono[3)] and Hideo Matsumura[3,4)]

[1)]Department of Aesthetic Dentistry, Nagasaki University Hospital of Medicine and Dentistry, Nagasaki, Japan
[2)]Dental Laboratory Center, Nagasaki University Hospital of Medicine and Dentistry, Nagasaki, Japan
[3)]Department of Fixed Prosthodontics, Nihon University School of Dentistry, Tokyo, Japan
[4)]Division of Advanced Dental Treatment, Dental Research Center, Nihon University School of Dentistry, Tokyo, Japan

(Received 5 April and accepted 2 May 2007)

Abstract: The root canal space prepared for a foundation restoration is often elliptic or too large, and an unintentionally prepared undercut is sometimes detected. This article presents a dental laboratory technique to reconstruct an endodontically treated tooth using a pre-impregnated fiber-reinforced composite (FRC) system instead of a conventional fiber post. Particular attention was paid to increase the volume of the fiber in the root canal, and care was taken to achieve adequate primary laboratory polymerization of the matrix monomer. This simple technique is useful in the fabrication of an FRC dowel core with increased fiber content. (J. Oral Sci. 49, 179-182, 2007)

Keywords: fiber-reinforced composite; foundation; indirect composite.

Introduction

Endodontically treated teeth often require substantial build up with varying dowel and core foundation materials prior to preparation of the coronal abutment structure. Over the years, various conventional fiber post materials and designs have been introduced (1,2), and their aesthetic outcome and efficiency in reducing the risk of root fracture have also been reported (3-6). The root canal space drilled for foundation restoration is often too elliptic, with too large a diameter, and too diverse for the conventional post. In addition, the root canal space is sometimes enlarged with an undercut. Consequently, clinicians should forego the use of conventional fiber posts and seek alternative methods to build up the core foundation.

The development of fiber-reinforced composites (FRC) may provide new potential applications in the clinical situation. Similar to direct/indirect foundation procedures using prefabricated fiber posts, the laboratory technique when using indirect FRC as the foundation restoration is a simple method and provides fixed prostheses that are aesthetic and potentially more durable. The purpose of this report is to present a clinical technique with a novel concept for a foundation using an FRC framework in detail.

Correspondence to Dr. Hideo Matsumura, Department of Fixed Prosthodontics, Nihon University School of Dentistry, 1-8-13 Kanda-Surugadai, Chiyoda-ku, Tokyo 101-8310, Japan
Tel: +81-3-3219-8145
Fax: +81-3-3219-8351
E-mail: matsumura@dent.nihon-u.ac.jp

Case Report

A 64-year old woman was referred by her dentist to the Department of Aesthetic Dentistry, Nagasaki University Hospital of Medicine and Dentistry for prosthodontic consultation and to address the aesthetic concerns of the patient. Among the prosthodontic restorations indicated, the patient selected a ceramic restoration for her maxillary lateral incisor because of its aesthetic advantage. For the dowel and core foundation of the tooth, the following indirect fabrication technique was planned since the root canal space had an accidentally drilled undercut area (Fig. 1).

1. Make an impression (Fig. 1), mount a working cast (Fig. 2), and apply separating medium (Estenia CR Sep, Kuraray Medical Inc., Tokyo, Japan).
2. Prepare a thick sheaf of glass fibers with proper length and diameter using a monomer-impregnated glass fiber material originally designed for tooth-

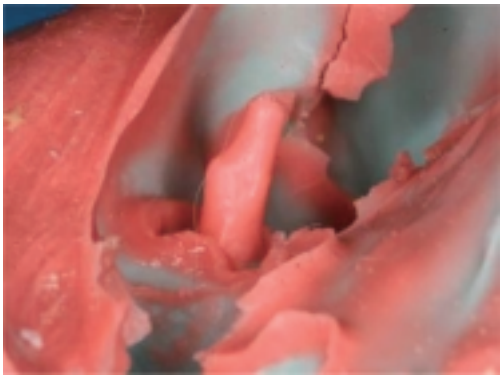

Fig. 1 Impression of the prepared root canal space. Note the accidental undercut.

Fig. 2 The working cast.

Fig. 3 Pre-impregnated fiber packed into the post space with a carver.

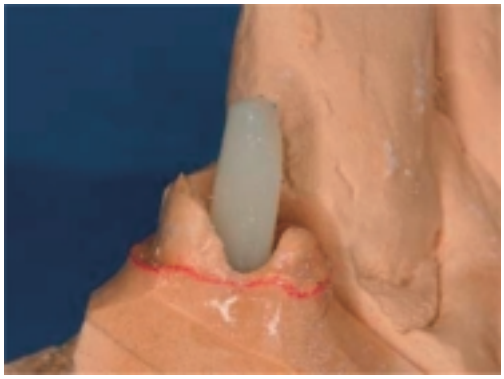

Fig. 4 Pre-impregnated fiber in the post space.

Fig. 5 Unpolymerized fiber post without an undercut after initial polymerization.

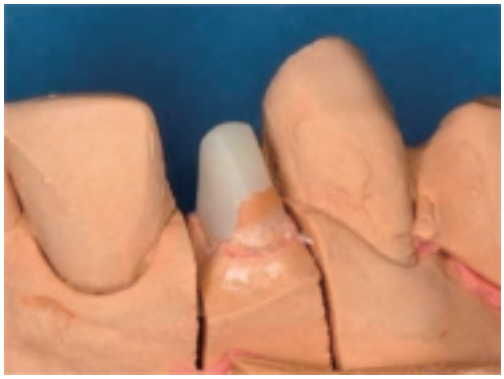

Fig. 6 Completed indirect core foundation.

Fig. 7 Dowel-core luted prior to preparation of the coronal abutment structure.

colored restorations and fixed partial dentures (Estenia EG Fiber, Kuraray Medical Inc.).

3. Pack the fiber into the prepared post space with a handheld instrument such as a carver, and ensure that the fiber reaches the bottom (Figs. 3 and 4).
4. Polymerize the fiber that has overflowed out of the cast with a light-polymerizing apparatus, remove it carefully from the cast (Fig. 5), polymerize the whole fiber post, and place it back onto the cast.
5. Cut the excess part of the fiber with a diamond disk, add composite (Estenia C&B, Kuraray Medical Inc.) to create an appropriate shape, adequately polymerize it using a proprietary light-polymerizing unit (α-Light IIN, J. Morita Corp., Suita, Japan) and an oven (KL-310, J. Morita Corp.), and complete the dowel-core foundation (Fig. 6).
6. Cement the dowel-core to the root using an appropriate luting system (Fig. 7).

Discussion

A prefabricated fiber post is generally cylindrical, and the diameters of the fibers are standardized in accordance with the system. For reduction of the stresses that cause root fracture, a long and thin fiber post is recommended for clinical foundations (6). In daily practice, however, clinicians often encounter a non-cylindrical and/or extensively enlarged root canal space. In addition, the space is sometimes accidentally prepared with an undercut. Prefabricated cylindrical fiber posts are occasionally inappropriate because of the lack of adaptation to such a root space.

The dowel-core foundation procedure using FRC in the current study was therefore employed so that root canal spaces, which usually differ widely, could be filled with the fiber as densely as possible. The monomer-impregnated glass fiber material used was originally designed for tooth-colored restorations and fixed partial dentures. This material was selected for the current technique, in place of the conventional fiber post, since the fiber can be easily prepared to a thick layer.

This technique is very simple and does not require any other laboratory apparatuses except for conventional indirect fabrication tools. After the initial polymerization, the fiber plugged in the post, which is still unpolymerized and flexible, can be easily taken out without fracturing the cast. As a result, this method is applicable to cases with unexpected undercuts in the root canal space (Fig. 1). The whole FRC should be sufficiently polymerized according to the manufacturer's instructions.

The bond strength between the luting material and post is affected by the surface treatment of the post (7-9). Air abrasion of the fiber surface improves the retention significantly (8). For the glass fiber material selected in the current study, air-abrasion with 50-70 μm alumina using an air abrader and treatment with an exclusive silane primer (Estenia Add-on Primer, Kuraray Medical Inc.) and bonding agent (Estenia Modelling Liquid, Kuraray Medical Inc.) should be performed after try-in.

As the bond strength between the luting material and post is also influenced by the type of the material (7,10), clinicians should select a resinous luting material which has sufficient mechanical properties and reliable bonding durability. For the current method, use of an adhesive composite resin luting agent (Panavia F 2.0, Kuraray Medical Inc.) as well as its exclusive dentin primer (ED Primer II, Kuraray Medical Inc.) is recommended.

A pre-impregnated fiber framework designed for tooth-colored fixed partial dentures may provide an effective and minimally invasive foundation. Further experiments such as stress analysis and clinical evaluation would clarify the effectiveness of this method in clinical practice.

Acknowledgments

This study was supported in part by a Grant-in-Aid for Scientific Research B 18390525 and C 17592030 from the Japan Society for the Promotion of Science (JSPS), and Sato Fund, Nihon University School of Dentistry.

References

1. Bateman G, Ricketts DN, Saunders WP (2003) Fibre-based post systems: a review. Br Dent J 195, 43-48
2. Nagase DY, Takemoto S, Hattori M, Yoshinari M, Kawada E, Oda Y (2005) Influence of fabrication techniques on retention force of fiber-reinforced composite posts. Dent Mater J 24, 280-285
3. Sirimai S, Riis DN, Morgano SM (1999) An in vitro study of the fracture resistance and the incidence of vertical root fracture of pulpless teeth restored with six post-and-core systems. J Prosthet Dent 81, 262-269
4. Hu YH, Pang LC, Hsu CC, Lau YH (2003) Fracture resistance of endodontically treated anterior teeth restored with four post-and-core systems. Quintessence Int 34, 349-353
5. Newman MP, Yaman P, Dennison J, Rafter M, Billy E (2003) Fracture resistance of endodontically treated teeth restored with composite posts. J Prosthet Dent 89, 360-367
6. Nakamura T, Ohyama T, Waki T, Kinuta S, Wakabayashi K, Mutobe Y, Takano N, Yatani H (2006) Stress analysis of endodontically treated

anterior teeth restored with different types of post material. Dent Mater J 25, 145-150
7. Sahafi A, Peutzfeldt A, Asmussen E, Gotfredsen K (2003) Bond strength of resin cement to dentin and to surface-treated posts of titanium alloy, glass fiber, and zirconia. J Adhes Dent 5, 153-162
8. Balbosh A, Kern M (2006) Effect of surface treatment on retention of glass-fiber endodontic posts. J Prosthet Dent 95, 218-223
9. Valandro LF, Yoshiga S, de Melo RM, Galhano GA, Mallmann A, Marinho CP, Bottino MA (2006) Microtensile bond strength between a quartz fiber post and a resin cement: effect of post surface conditioning. J Adhes Dent 8, 105-111
10. Bitter K, Priehn K, Martus P, Kielbassa AM (2006) In vitro evaluation of push-out bond strengths of various luting agents to tooth-colored posts. J Prosthet Dent 95, 302-310