Prefabricated, Preimpregnated Fibre Reinforced Resin Composite Pontic For Provisional Replacement of A Missing Tooth: A Case Report

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Abstract

The loss of an anterior tooth due to periodontal reasons, endodontic reasons or due to trauma has a great psychological effect upon the patient. His primary concern is the restoration of an esthetic appearance. Fiber-reinforced composite resin (FRC) prostheses offer the advantages of good aesthetics, minimal invasive treatment, and an ability to bond to the abutment teeth, thereby compensating for less-than-optimal abutment tooth retention and resistance form. These prostheses are composed of two types of composite materials: fiber composites to build the framework and hybrid or microfill particulate composites to create the external veneer surface. This case report is based on the use of fiber reinforcement in the fabrication of composite-fixed partial dentures of conventional preparation. The possibilities fiber reinforcement technology offers must be emphasized to the dental community. Rather than limiting the discussion to whether FRC prostheses will replace metal-ceramic or full-ceramic prostheses, attention should be focused on the additional treatment options brought by the use of fibers. However, more clinical long term studies are needed.

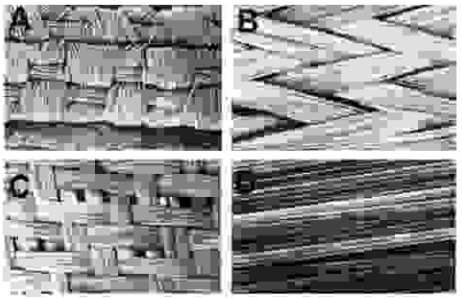
Introduction

Traditional metal reinforced bridges are characterized by certain disadvantages. These disadvantages culminate in the bonding and aesthetic problems of metal frameworks. Fortunately, these problems can now be overcome, to a large extent, by the use of fiber reinforced composite (FRC). In fact, the bond strength between the prostheses and the abutment teeth obtained when using FRC materials is 50-100 % higher than the bond strength achieved when using metal framworke.[1] In addition, in FRC restorations the glass fibers are translucent and covered with veneering composites, resulting in good aesthetic restorations, which do not increase plaque accumulation.[2] Metal-free prostheses continue to gain interest. Although the metal alloys contribute great strength to the prostheses, they do so at a considerable aesthetic liability. Two somewhat different metal free approaches to fixed tooth replacement continue to be developed for a variety of clinical applications. These are all-ceramic and all-composite systems. Composite or polymeric prostheses generally consist of a particulate composite veneer supported by a FRC-substructure (framework).

With FRC prostheses, there are two approaches in using fibers: one is based on conventional made restorations while the other is based upon using fibers in minimally invasive restoration by direct or indirect fabrication. FRC-supported prostheses have undergone much testing recently in the laboratory and in the patient's mouth.[3-7] The FRC prostheses can be fabricated indirectly in the prosthetic laboratory by a dental technician, chair side in the dental clinic by the dentist, or directly in the patient's mouth. Veneer materials used for the chair side-fabricated prostheses are light cured hybrid or microfill composites typically found in the dental clinic. Laboratory-made prostheses, including the FRC framework, are also light cured but may have an additional heat polymerization stage with the optional use of vacuum or pressure to enhance polymerization. Deep polymerization improves mechanical properties, especially the flexural strength of the FRC framework and wear resistance as well as color stability of the veneering composite.[8]

What is preimpregnated fibre reinforced resin composite (FRC) ???

FRC consists of bundles of long glass fiber preimpregnated with a resin matrix to make frameworks for fixed prosthesis. Pre-impregnated fiber reinforced resin composite provides the potential for a metal free, ceramic free prosthesis with potential for long term durability and excellent esthetics. The FRC form of framework over which particulate composite is built up. Different types of FRC materials exhibiting a wide variety of mechanical flexural properties are commercially available. The mechanical properties of FRC materials are primarily dependent upon fiber type (glass, carbon, aramid, or polyethylene), quantity of fibers in the matrix resin (maximum is 15x103 in a bundle), fiber architecture (unidirectional, woven, or braided), and quality of impregnation of fiber with resin. (Fig. 1)



Some manufacturers produce dry fibers that require hand impregnation by the technician or the dentist, e.g. Ribbond, Glas Span, and Construct. Some of the commercially available FRC materials are machine impregnated with resin by the manufacturer, e.g. EverStick, FiberKor, and Vectris. These machine-impregnated materials are also known as pre-impregnated FRC materials. The mechanical and handling properties of machine-impregnated FRCs are better than those of the hand impregnated FRCs. Rigidity of the FRC framework is crucial for the integrity of the veneer, made from a brittle material, such as particulate filler composite.

The ultimate flexural strength of manufacturer impregnated (pre-impregnated) unidirectional glass FRC material ranges from 500 to 1200 MPa.[10] This is greater than the flexural strength of noble alloys.[9] For polyethylene fiber composites, flexural strength values are lower than glass or carbon fiber composites. Clinical tooth replacement applications of FRC-reinforced prostheses are organized into two categories: laboratory-fabricated prostheses and chair side prostheses.[11]

Early Formulations

- Composed of woven glass or polyethylene fibres which were hand impregnated with a composite or unfilled resin by the dentist or technician.
- Used for bonded prosthesis, splints and retainers.

Disadvantages

- Undesirable handling characteristics.
- Opaque appearance.
- Did not bond well to enamel or other resin composite materials.

Latest Formulations

- The improved FRC are light and heat polymerized and contains (S 2) glass fibres and the resinous matrix (BIS-GMA) which are coupled during the manufacturing process.

Advantages

- Handling much more easier.
- They have 7 times the strength of particulates.
- They have 10 times the flexural modulus of particulate composite.
- Better wear resistance, increased elasticity and increased impact / fracture resistance.

Case Selection For A Fixed Frc Prosthesis

Indications

- Patient requiring an optimal esthetic result.
- Desire for a metal free, porcelain free prosthesis.
- Desire to decrease the potential wear of the opposing tooth (v/s porcelain).
- A fixed space maintainer for adult or pediatric patient after orthodontic treatment.
- Patients with abutments having questionable periodontal prognosis.
- Patients who can not tolerate local anesthesia and sit for extended periods of time due to medical reasons.
- As a fixed temporary tooth replacement for implant cases prior to loading the implant.
- Desired to use an adhesive approach to the abutment tooth.
- Cases of incompatibility with metal.
- Cost effective.

Contraindications:

- Inability to obtain good moisture control, where the use of an adhesive technique can not be successfully performed.
- A prosthesis that involves two or more pontics i.e. long span bridges.
- Patients who exhibit para-functional habits.
- Presence of unglazed porcelain opposing the prosthesis.
- Patients who abuse alcoholic substances.

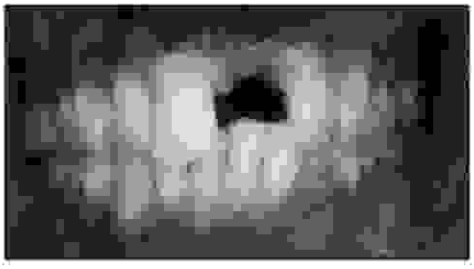
The preimpregnated fibre reinforced composite material used in this case is TARGIS VECTRIS (Ivoclar / Williams). Vectris has 3 orientations of its R Glass fibers, which are embedded in a BIS-GMA, decandiol dimethacrylate, and urethane dimethacrylate. Vectris pontic has parallel glass fibers which is composed of a satin weave of 30° bias cut fibers. The Targis particulate composite veneering material is composed of polycarbonate dimethacrylate, ethoxylated A dimethacrylate, and triethylene glycol dimethacrylate + barium glass, mixed oxides and dispersed silica as fillers. Targis has an average particle size of 1µm, is 78% filled by weight, and is light and heat cured.

Criteria for selecting of abutment teeth

- Teeth with minimal to no existing restorations.
- Abutment teeth those are acceptable in shape, position and colour.
- Abutment teeth with enough bucco-lingual thickness to permit a 2mm deep intracoronal preparation.

Case report

A 32 year male patient presented to the department with chief complaint of missing left upper front tooth for last 1 month. (Fig. 2) History revealed that he had a trauma on

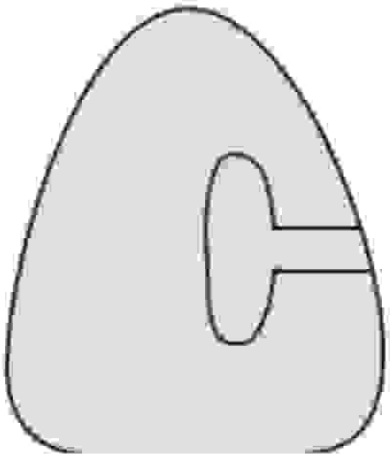


face 30 days back. Following this patient had undergone extraction of maxillary left central incisor. Clinical and radiographic examination showed adjacent teeth with sound bone support without any crown or root fracture. The patient's medical history was non contributory. Patient was given a choice between implant or PFM bridge but due to economic constrains he was not willing for any permanent treatment at this point of time. also patient desired a fixed rather than a removable provisional prosthesis to replace the missing central incisor. Therefore, the treatment plan of FRC pre impregnated fibre reinforced resin composite pontic for provisional replacement of a missing tooth was formulated and the consent of the patient was taken subsequent to due explanation.

Preparation of abutment teeth

Abutment teeth prepared with a slot (Fig. 3)

- Depth of 2 mm.



- Length of 1.5 to 2mm

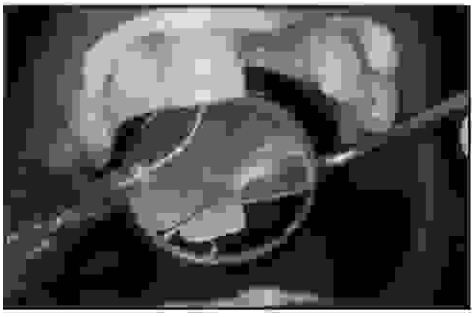
Fabrication

Following preparation of slot on both the abutment teeth i.e. maxillary right central incisor and left lateral incisor an impression of the arch was made and cast was poured. A thin layer of particulate composite (Tetric Flow; Ivoclar Vivadent) was placed on the floor of the preparation of the dies, light polymerized, and then 6 to 7 FRC strips (Targis Vectris, Ivoclar / Williams) were cut and placed over the particulate layer within each preparation and across the edentulous space (Fig.4). The

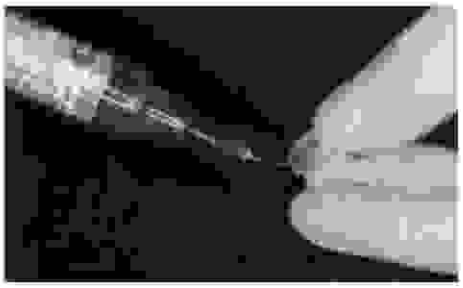
pontic support segments were attached to the FRC strips using a dual-polymerizing composite resin (Variolink II, Ivoclar Vivadent, Schaan, Liechtenstein) that was briefly exposed (4 seconds) to visible light polymerization ((Astralis 10; Ivoclar Vivadent) (Fig.5).

The wing of the framework is positioned on the lingual surface of the abutment tooth. This is determined by the amount of incisal clearance with the opposing teeth. A Mylar strip was placed between the teeth to limit the extent of spread of the adhesive and

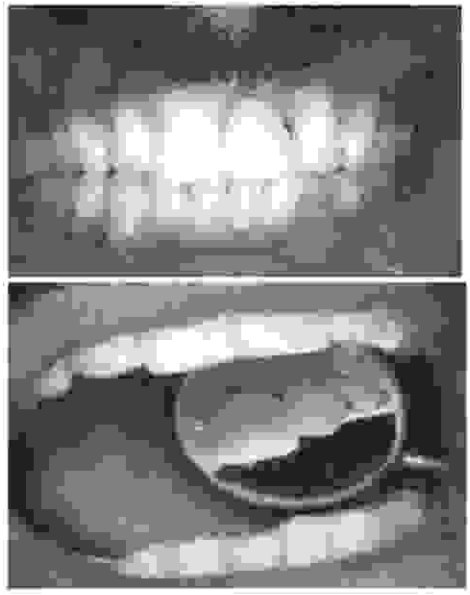
flowable resin. The palatal surface of the abutments was etched with a phosphoric acid gel (Ivoclar Vivadent, Amherst, NY). (Fig.6) and an adhesive (Excite: Ivoclar



Vivadent) was placed. The wing is polymerized to the etched adhesive surface of the abutment tooth by a visible light-polymerizing unit using through the abutment tooth for a lingual attachment. (Fig.7) The framework was positioned



using a curved hemostat to hold the pontic substructure to the desired position within the edentulous space, and a gloved finger compressed the wing against the lingual surface of the abutment teeth. The wing/flowable composite resin complex was polymerized from the facial direction for 60 seconds using a visible light-polymerizing unit (Astralis 10; Ivoclar Vivadent) at a power density of 800 mW/cm^2 to initially tack the complex to the tooth, then polymerized again from the lingual for an additional 40 seconds to complete the polymerization process. The pontic shape was finalized using particulate composite resin (Tetric Ceram; Ivoclar Vivadent) to create a natural and esthetic appearance (Fig.8 &9) This FRC



provisional partial denture can be easily removed using a 12-bladed finishing bur by grinding away the winged segment of the partial denture with minimal loss of enamel on the lingual surface of the abutment tooth.

Summary

The use of a prefabricated FRC framework to fabricate a chairside provisional partial denture provides the clinician with another option for managing esthetics and function for placement in the anterior region.[12-15] This type of fixed tooth replacement provides the patient with a reliable alternative to the palate-supported removable prosthesis. The advantages of this approach include the efficiency of having a framework prefabricated the strength provided by the resin-preimpregnated FRC in supporting the particulate composite resin, both in the pontic and the connector area, and the ability to involve only 1 of the adjacent teeth around the implant for the attachment of the interim prosthesis. This permits ease of cleaning under the pontic and around the healing implant, and less time for placement and removal by the dentist.

Rather than limiting the discussion to whether FRC prostheses will replace metal-ceramic or full-ceramic prostheses, attention should be focused on the additional treatment options brought by the use of fibers. However, more clinical long term studies are needed.

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