

Esthetic Rehabilitation of Anterior Missing Teeth by Fiber-reinforced Composite: A Case Report

Mansi Singh*, Amina Khan, Afsana Ansari, Krati Sharma, Sunidhi Sharma

Department of Prosthodontics, Crown and Bridge, Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India

Abstract

Background: Some patients refusing implant surgery for psychological reasons, where minimal tooth reduction is preferred, a fiber-reinforced composite (FRC), inlay, and fixed partial denture (IFPD) can be a good alternative to conventional prosthetic techniques. In comparison to other restorative systems, this is a conservative approach carries a minimum jeopardy of pulp exposure or sensitivity and periodontal inflammation, maintaining the health of supporting tissues. The purpose of this case report is to illustrate the clinical procedure for fabricating an IFPD with a pre-impregnated glass fiber system and a hybrid composite. FRC, in combination with adhesive techniques, appears promising for an IFPD. Further clinical investigation will be required to provide additional information on this technique.

Keywords: Adhesive dentistry, fiber-reinforced composite, glass fibers, metal-free restoration.

INTRODUCTION

Different therapeutic options can be considered for the replacement of a congenitally or traumatically missing permanent incisor in young children and adolescents. Implants are the treatment of choice and should be considered when general and local conditions are favorable. Their use is generally not intended before the end of the growth period and around the age of 18 years. Because of their high cost, poor financial condition could also limit their use. More economically acceptable treatments should, therefore, be investigated for the replacement of a missing tooth, as a main treatment or as a long-term provisional treatment before implant therapy.

Partial removable dentures are often recommended for very young patients when adjacent teeth are not in their final vertical and horizontal positions. These dentures could be modified when necessary by adding or grinding the acrylic resin. They are not comfortable, however, and are frequently subjected to fracture. When an orthodontic treatment is indicated, an artificial plastic tooth can be attached to a removable or fixed orthodontic appliance to solve the esthetic concern.

The replacement of a missing tooth can also be made through a conventional porcelain-fused-metal bridge or a resin-bonded fixed partial denture (Maryland bridge). The former is the most invasive treatment in terms of tooth reduction and could be esthetically compromised with gingival contour modifications.

The latter is less invasive, but the non-esthetic aspect of the metal framework, necessity of dental reduction or preparation (grooves, etc.), challenging long-lasting bonding of metal to tooth, and lack of longevity could limit its use. The fiber-reinforced composite (FRC) bridges represent an interesting alternative to conventional metal bridges.^[1] They could be made directly or indirectly using an artificial plastic tooth or the avulsed tooth,^[2,3] or by a direct build up composite resin tooth with^[4,5] or without^[6] porcelain veneering.

Whenever possible, a FRC bridge should be fabricated extra-orally to achieve better polish, polymerization conversion rate, and adaptation. The material used for the cast fabrication can be conventional gypsum materials type III. Two appointments are, therefore, necessary for this indirect technique. Moreover, the separation of the final work from the cast could be delicate if undercuts are filled by composite resin.

The new generation of composite resins with dentin and enamel shades provides very good esthetic results by reproducing the natural aspect of the tooth, mainly in the incisal third of anterior teeth.^[7]

Address for correspondence: Dr. Mansi Singh,
Santosh Deemed to be University, Ghaziabad, Uttar Pradesh, India.
Email: mansi.singh@santosh.ac.in

Received: Mar. 06, 2021; **Accepted:** Apr. 24, 2021; **Published:** Apr. 30, 2021

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

How to cite this article: Singh M, Khan A, Ansari A, Sharma K, Sharma S. Esthetic Rehabilitation of Anterior Missing Teeth by Fiber-reinforced Composite: A Case Report. J Res Adv Dent 2021;12:3:50-54.

Access this article online

Website:
www.jrad.co.in

DOI:
<https://doi.org/10.53064/jrad.2021.12.3.10>

The use of unreinforced composite resins as the structural material for bridges often results in fracture. Composites are brittle materials and contain bubbles, cracks, and other defects causing or facilitating fissure propagation and fracture.^[8] It has been demonstrated that the reinforcement of a composite resin by fibers increases the fracture toughness and resistance.^[9] The combination of an esthetic, wear-resistant composite resin, and tough fiber material gives a new option for short-span composite bridge fabrication.^[10]

Structurally, the FRC is made up of two components: The fibers and the resin matrix. The resin matrix serves as carries protector, and load-splicing medium around the fibers. To improve the mechanical properties of composite resins and to optimize the mechanical behavior of the material, specifically-oriented filler materials, such as glass fibers, aramid fibers, carbon/graphite fibers, and ultra-high molecular weight polyethylene fibers, have been proposed. Polyethylene and glass fibers are the materials most frequently used for FPDs. *In vitro* studies have shown the clinical and mechanical performance of FRC depends on several factors, including fiber direction and pretreatment.^[11]

Unidirectional fibers are anisotropic with high strength in one direction, while bidirectional fibers give so-called orthotropic properties to the material in one plane and random-oriented fibers give isotropic properties.^[11] To reinforce the restoration in multiple directions woven fibers and meshes have been proposed.^[12] Resin pre-impregnated and non-impregnated fibers are available on the market. Pretreatment of fibers with a silane coupling agent appears to minimize shrinkage on polymerization and reduce cracks and pockets, ensuring reliable adhesion between fibers and resin matrix.^[13]

This article describes a clinical case in which an (FRC) bridge is fabricated according to the semi-direct technique for the replacement of a traumatically missing central permanent incisor.

CASE REPORT

A 17-year-old boy visited in the department of prosthodontics; with the chief complain of missing lower front teeth since birth. Patient asked for a more esthetic and comfortable treatment. For the intra oral examination it was found missing 41 teeth (Figures 1 and 2). All therapeutic options, from implant to conventional Maryland bridge, were, therefore, possible in this case. After discussing all treatment options with the patient, it had been decided to place a FRC Maryland-like bridge until the implant treatment.

An impression was made with alginate for the FRC bridge fabrication. The impression was poured with type III gypsum material. The length measurement was conducted with thin soft foil. This foil was directly adapted to the working cast. The foil extended to the middle thirds of each abutment and passed over the pontic area directly under the incisal edge. The foil was used as a guide, for the exact length of the ribbon needed for fabrication of the FRC bridge. One should avoid

touching the ribbon until after it is wetted with bonding resin through the fingers, because any contact can contaminate its reactive surface layer.

The reinforcement material was impregnated with a hydrophobic solvent-free bonding resin (One Coat Bond SL, coltene). Following the impregnation with the bonding resin, the fiber material became translucent. The excess unfilled bonding resin was blotted with a gauze. The ribbon was kept out of the dental light until used. A thin layer of a micro-hybrid restorative material was placed on the lingual side of the abutment teeth. This composite acted as adhesive and held the ribbon during its adaptation. Using instruments, the ribbon was pushed through the uncured composite layer until it touched the surface of the die material. Like the foil, the ribbon crossed the pontic area under the incisal edge, going from the labial lingual midline of each abutment.

The thickness of the composite between the teeth and ribbon was kept as thin as possible. The ribbon wings and beam were light cured for 40 s to form a strong framework for the FRC bridge fabrication. A second fragment of the ribbon was placed in the pontic region at this stage. A silicone spatula was used to model the composite and obtain a very thin layer of the covering composite (Figure 3). This technique provided a bubble-free and harder surface in comparison to the use of a flowable composite as the smoothing layer.

The composite pontic was built around the composite laminate framework. To obtain a good natural esthetic result, a composite restorative system (SwissTEC, Coltene) containing different enamel and dentin shades was used.

Dentin shades, responsible for the opacity, hue, and chroma, were placed internally and then covered by enamel shades. The bridge was finished and polished with appropriate instruments (Figure 4). The bridge was inserted into the mouth to check its fit. It was rinsed with alcohol to remove any traces of polishing pastes, and then rinsed with water and air dried. The internal side of the wings was acid-etched (Scotchbond™ Universal Etchant, 3M ESPE) for 1 min and then thoroughly rinsed and completely air dried. A porcelain primer (Silane, 3M ESPE) was then applied for 30 s and air dried.

Enamel surfaces were etched with 32% phosphoric acid (Scotchbond™ Universal Etchant, 3M ESPE) for 30 s. After rinsing, all surfaces were air dried, visually inspected or proper acid etching and covered by two layers of a universal 1-bottle adhesive (One Coat Bond SL, coltene). The adhesive layer was air dried and light cured for 10 s. A thin layer of dual-cured luting composite (RelyX U200, 3M ESPE) was placed on the wings' internal surface. The bridge was inserted slowly and continuously (Figure 5). Once in place, it was held firmly in position. Excess cement was removed using a probe and brush. The bridge was then light cured for 2 min in different directions. Occlusion was verified before intraoral finishing and polishing. The final result was a well-adapted bridge with a natural esthetic result (Figures 6-8).



Figure 1: Frontal profile



Figure 2: Intraoral frontal profile



Figure 3: Final impression

DISCUSSION

The replacement of a congenitally or traumatically missing tooth could be performed through different therapeutic options. FRC bridges are one of these options, with several advantages including bond ability, reparability, ease of fabrication, and relative longevity and cost effective and labor intensive. This is a minimally invasive procedure with very little or no tooth preparation.



Figure 4: Extraoral pontic fabrication



Figure 5: Adaptation of composite band



Figure 6: Final prosthesis

Compared to direct technique, the indirect technique described in this article provides a better result in terms of adaptation, rate of polymerization, reduced chair side time, and final finishing and polishing of the bridge. With a direct technique, it is very difficult to control and avoid the excess composite in embrasures and undercuts. After curing, the composite can only be removed by rotary instruments. The use of burs is time consuming, imprecise, and possibly invasive. The lack of visibility and access could lead to fiber exposition during finishing and polishing procedures and achieving these procedures with clean dry field become difficult.

The fabrication of an FRC bridge using a die model brings advantages in comparison with traditional indirect technique.



Figure 7: Intraoral frontal prolife



Figure 8: Extraoral frontal prolife

A chair side FRC bridge fabrication could be performed easily, reducing lab fees, and time. The model allows for the easy removal of the final work without weakening or breakage of the bridge. Moreover, the FRC bridge fabrication can immediately be undertaken with no required isolation.

Plasma-treated polyethylene fibers reinforce the final structure by being a physical part of the composite. FRC bridge compared to metal Maryland bridge is easier to bond, more esthetic with no metal silhouette and does not show through the very translucent dental hard tissues in young permanent teeth.

The use of different dentin and enamel composites to build up the intermediate tooth according to the anatomical layering technique provides a vital final aspect, with natural opalescence, translucency, and opacity. The use of a denture tooth could also be considered instead of direct fabrication of the missing tooth. This method is easier, faster, and more esthetically acceptable.

The mechanical properties of FRC must be improved so as to reduce the risk of clinical failure due to catastrophic fracture.^[14] The fracture strength of FRCIFPD depends on several factors including: the elastic modulus of the supporting substructure, the preparation design, occlusal load of the span and the characteristics of the manufacturing process, and the materials used to fabricate the prosthesis.

Few studies have emphasized on cavity preparation for FRC, and the principles governing standard cavity preparation have not been established. When making box preparations for an FRC, if pre-existing restorations are present, they can determine abutment shape. Otherwise, when teeth are intact, mechanical, and biological aspects must be considered in choosing the preparation design: The proximal box should be as deep as possible in the gingival direction to ensure an adequate amount of FRC and to provide maximal strength in the connection area. At the same time, the margins must be located within the enamel for better long-term marginal adaptation.^[15] The manufacturing process also influence the mechanical properties of the FPD.

CONCLUSION

Replacement of missing tooth with FRC technique offered in this article suggests a new treatment alternative. This technique restores esthetic and function. It is more comfortable than a removable appliance, nonirritating, and hygienic. It does not require any tooth reduction or minimum reduction is required and could be repaired, modified, or removed from teeth without any iatrogenic problem. It can be considered a stable treatment or a long-lasting provisional treatment if implant therapy is used at a later date. In this case, the non-invasive characteristic of this treatment render it superior to all other options.

CONFLICTS OF INTEREST

The authors declare that they have no potential conflict of interests regarding this article.

REFERENCES

1. Vallittu PK. Survival rates of resin-bonded, glass fiber reinforced composite fixed partial dentures with a mean follow-up of 42 months: A pilot study. *J Prosthet Dent* 2004;3:241-6.
2. Nixon RL, Weinstock A. An immediate-extraction anterior single-tooth replacement utilizing a fiber-reinforced dual-component bridge. *Pract Periodontics Aesthet Dent* 1998;10:17-26.
3. Belli S, Ozer F. A simple method for single anterior tooth replacement. *J Adhes Dent* 2000;2:67-70.
4. Feinman RA, Smidt A. A combination porcelain/fiber reinforced composite bridge: A case report. *Pract Periodontics Aesthet Dent* 1997;9:925-9.
5. Miller MB. Aesthetic anterior reconstruction using a combined periodontal/restorative approach. *Pract Periodontics Aesthet Dent* 1993;5:33-40.
6. van Wijlen P. A modified technique for direct, fiber-reinforced, resin-bonded bridges: Clinical case reports. *J Can Dent Assoc* 2000;66:367-71.
7. Vanini L. Light and color in anterior composite restorations. *Pract Periodontics Aesthet Dent* 1996;8:673-82.
8. Rudo DN, Karbhari VM. Physical behaviors of fiber reinforcement as applied to tooth stabilization. *Dent Clin North Am* 1999;43:7-35.
9. Pfeiffer P, Grube L. *In vitro* resistance of reinforced interim fixed partial dentures. *J Prosthet Dent* 2003;89:170-4.
10. Fahl N Jr. Restoration of the maxillary arch utilizing a composite resin buildup and a fiber framework. *Pract Periodontics Aesthet Dent* 1998;10:363-7.
11. Tezvergil A, Lassila LV, Vallittu PK. The effect of fiber orientation on the thermal expansion coefficients of fiber-reinforced composites. *Dent Mater* 2003;19:471-7.
12. Kanie T, Fujii K, Arikawa H, Inoue K. Flexural properties and impact strength of denture base polymer reinforced with woven glass fibers.

- Dent Mater 2000;16:150-8.
13. Behr M, Rosentritt M, Lang R, Handel G. Flexural properties of fiber reinforced composite using a vacuum/pressure or a manual adaptation manufacturing process. J Dent 2000;28:509-14.
 14. Kelly JR. Perspectives on strength. Dent Mater 1995;11:103-10.
 15. Song HY, Yi YJ, Cho LR, Park DY. Effects of two preparation designs and pontic distance on bending and fracture strength of fiber-reinforced composite inlay fixed partial dentures. J Prosthet Dent 2003;90:347-53.