

Aesthetic Replacement of Missing Tooth Using Fiber Splint

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Abstract

Replacement of the missing or lost teeth is one of the major challenges faced by the dentists, especially in children. Since years, many modes of treatment options have been available such as removable temporary acrylic prosthesis or resinbonded bridges variety of therapeutic modalities, and from implants to conventional Maryland bridges. But the recent inception of fibre-reinforced composites (FRCs) in tooth replacement therapy has opened a new perspective in the field of restorative dentistry. Fibre-reinforced composites have been incorporated with better properties with flexural strength and fracture resistance. FRC bridges are easy, minimally invasive and reversible and a single visit procedures. It also lets other options viable for future, if need be. This paper presents a case of a missing mandibular left central incisor, which were replaced with acrylic tooth pontic using fibre-reinforced composite. .

Key Words: Fibre-reinforced composite, missing teeth, conservative, minimal invasive, acrylic pontic, single visit

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I. Introduction;

Fiber-reinforced composites (FRC) are resinbased materials containing fibers aimed at enhancing their physical properties. These were first introduced in the 1960s by Smith when glass fibers were used to reinforce polymethylmethacrylates [1]. The development of the fiber-reinforced composite technology has brought a new material into the realm of metal-free adhesive esthetic dentistry [2]. Different fiber types such as glass fibers, carbon fibers, Kevlar fibers, Vectran fibers, and polyethylene fibers have been added to composite materials [3]. Glass fibers, consisting of glass interlaced filaments, improve the impact strength of composite materials. They have excellent esthetic properties, but they do not easily stick to the resinous matrix [4]. Carbon fibers prevent fatigue fracture and strengthen composite materials, but they have a dark color that is esthetically undesirable [3,5,6]. Kevlar fibers, made of an aromatic polyamide, increase the impact strength of composites, but they are unaesthetic, hence their use is limited [7]. Vectran fibers are synthetic fibers made of aromatic polyesters. They show a good resistance to abrasion and impact strength, but they are expensive and not easily wielded [3]. However, polyethylene fibers improve the impact strength, modulus of elasticity and flexural strength of composite materials. When compared to other fibers, they are almost invisible in the resinous matrix. Due to these reasons, they are the most appropriate and the best esthetic strengtheners of composite materials [3]. The use of this fiber is based on the clinical reports of tooth replacement by Bradenstein and Sperber, Marcus, and Millerand Portilla, among others [6]. This fiber has been described as being used for perio splints strengthening removable prosthesis, prosthesis, post and core fabrication, and provisional use.[7]

The development of adhesive technique and fiber-reinforced composite (FRC) resins materials has thus provided the chair side approaches for stabilizing mobile teeth and replacing missing teeth conservatively and cost effectively.[8]

When replacing missing anterior teeth, thorough treatment planning is essential. Correct choice of materials and bonding techniques are important factors to fulfill the need for durable restoration without compromising aesthetics of FRC-fixed partial denture.[9] The FRC prosthesis fabricated using two approaches, the first approach is based on conventional tooth preparation and laboratory made restoration, second approach is based on using fibers in minimally invasive restoration by direct or indirect fabrication. [10]

This paper presents a case of a missing mandibular left central incisor, which were replaced with acrylic tooth pontic using fibre-reinforced composite.

II. Case Report ;

A 43 years old lady was referred to Aesthetics Dental Clinic, Athens, Greece, with the chief complaint of unaesthetic appearance and discomfort during function, associated with the mandibular anterior teeth. Patient had lost mandibular left central incisor due to advanced periodontal disease (Figure-1). Clinical and radiographic examination revealed that the patient had maximum intercuspal position, moderate bone loss with Grade I tooth mobility in mandibular anterior teeth (according to the Miller index for tooth mobility).



Fig 1; Preoperative view of missing left lateral incisor due to advanced periodontitis
The teeth were scaled and root-planed to assure that all calculus and stains were removed.

After phase-I periodontal treatment the use of direct fixed partial prosthesis with polypropylene fiber reinforced composite was proposed as a quick, economical and, non invasive procedure. This procedure is an alternative to the removable partial denture, resin retained prosthesis and conventional fixed partial denture to rehabilitate the prosthetic space and create a periodontal splint for the abutment teeth.



Figure-2; FRC Bridge with acrylic teeth

The teeth were cleaned on the facial and lingual surfaces using a prophylaxis cup with a nonfluoridated pumice paste. The length of reinforced fiber (Interlig, angelus) (Figure-2) was determined by placing the dental floss on facial side of the mandibular anterior teeth from distal end of left canine to distal end of right canine. After the teeth were thoroughly rinsed and dried, the lingual surface of teeth to be splinted were etched with 37% phosphoric acid for 30 seconds. The preparations were rinsed with water and dried leaving the etched surface slightly moist.

A bonding agent was applied on all the prepared abutments and fiber mesh. The excess bonding agent was removed, a thin layer of flowable composite was applied to the lingual surface of abutment, and the length of polyethylene fiber mesh was carefully placed on the lingual surface of the abutments just above the cingulum, composite was again applied over the fiber mesh. The restoration were polymerized for 30 seconds with light polymerizing unit at 420mw/cm² from lingual and facial surface of abutment and edentulous space. (Figure-3)



Figure-3; Composite resin placed on the lingual surfaces and into the Class 3 preparations and lingual groove in natural tooth pontic.

Composite pontic was prepared on to the facial aspect of already cured fiber band in the edentulous space. Additional composite resin was applied to blend the FRC contours and light polymerized. Incisal adjustments were accomplished and final finishing and polishing done (Figure-4). Routine oral hygiene instructions were given, the patient was evaluated every 6 months for review and periodontal therapy was observed to be effective in obtaining optimal oral health. Periodontally compromised abutment teeth exhibited signs of periodontal health, patient was highly satisfied with aesthetic and functional outcome of the treatment. (Figure-5)



Figure-4; Lingual view of final esthetic result of the natural tooth pontic bridge reinforced with Ribbond, Facial view of the natural tooth pontic bridge reinforced with Ribbond THM and bonded composite resin.

III. Discussion;

Modern conservative dental treatment prefers minimal invasive options rather than the relatively destructive treatments used in the time of amalgam and gold alloys. Use of all-ceramic restorations still requires large preparations of tooth as well. Minimal invasive treatments became possible in restorative and prosthetic dentistry through the development of enamel and dentine bonding techniques, and through the improvement of restorative materials, especially resin composites.[9] However, inadequate mechanical properties, especially flexural strength, fatigue strength, and toughness of resin composites made of particulate fillers, have limited their use in heavy load bearing areas in single restorations, and especially in fixed prostheses.[10]

The use of FRCs in dental applications has been discussed in the literature since the early 1960s. [1]However, it took almost 30 years before dental FRCs were applied in clinical use. FRCs are structural materials that have at least two distinct constituents. The reinforcing component provides strength and stiffness, while the surrounding matrix supports the reinforcement and provides workability (Fig. 5). The polymer matrix also protects the fibers from the effects of mechanical damage and moisture [11]



Figure-5;Final labial smile

The recurrent fractures of removable dentures can be eliminated by the use of FRC as a reinforcement [12]. The impact strength of maxillary complete denture can be increased by a factor greater than two when reinforced with bidirectional FRC [13]. However, as in the cases of any other applications for fiber reinforcement, the positioning of fiber is of importance in order to achieve an efficient reinforcing effect [12]. FRC can also be used as framework in overdenture or implant-supported prosthesis. Combining FRCs with light-polymerizable dimethacrylate resins and particulate filler composite systems enables the use of fibers in fixed prosthodontics and other adhesively luted restorations. FRC-based resin-bonded restorations are claimed to have certain benefits over conventional materials. Lower elastic modulus of FRC in comparison with cast metal alloy helps to diminish interfacial stresses between the tooth and the resin-bonded fixed partial denture (FPD). Fixed restorations using adhesive technique can be fabricated using either a direct or indirect technique. With the indirect technique, the restorations are manufactured by a dental technician and adhesively luted in place with a luting resin cement [14,15], whereas in the direct technique, preimpregnated FRCs are used by the dentist as a chairside approach for teeth replacements [2,16,17]. Surface-retained, inlay, onlay, and full-cover crown-retained devices can be used. According to the clinical need, hybrid-type fixed prosthesis can be prepared by integrating various retainer types into the same prosthetic device.[17]

Different materials have been successfully used for splinting which include—composite, wire and composite and fiber reinforced splints. In order to fulfill both the periodontal and restorative needs, ribbons and fibers were developed that could be reinforced with composite resin to form thin-but-strong splints. [8,9,10]

The advantages of fiber reinforced composite material for periodontal splinting include:

- a. Ease of application with minimal tooth preparation. [1,8,9,10]
- b. Low to moderate cost as compared to fixed prostheses.[9]
- c. Can easily be removed when splinting is no longer considered necessary[8].
- d. Easily repaired in case of failure through re-bonding and re-application of material.[4]
- e. Ease of accommodation of oral hygiene practices by the patient.[18]

When replacing missing anterior teeth, thorough treatment planning is essential. Correct choice of materials and bonding techniques are important factors to fulfill the need for durable restoration without compromising aesthetics of FRC-fixed partial denture. [1,8]The FRC prosthesis fabricated using two approaches, the first approach is based on conventional tooth preparation and laboratory made restoration, second approach is based on using fibers in minimally invasive restoration by direct or indirect fabrication.[19]

Factors affecting the success rates of FCRs (1,8,9,10) ;

- 1. A well-designed preparation of the abutment teeth.
- 2. Potential reinforcement provided for polyethylene fibers; adhesion between the fiber and the composite could increase the resistance and the hardness of the material allowing deflection without fracture.[9]
- 3. The prosthetic space in resin-bonded FPDs; the distance should not be larger than 15mm, because the FPD would suffer a higher deflection and could be unsuccessful. A large prosthetic space in the mandible might increase the failure rate to 3 times. [10]

Other applications of FRCs:

- a. Can be used as a fixed replacement following tooth loss from trauma. [8]
- b. In medically compromised patients as a fixed tooth replacement who cannot be seated for longer periods of time or have local anesthesia. [9]
- c. As an alternative splint in anterior periodontal tooth stabilization¹⁴ or with periodontally compromised abutments.[8]

d. As a direct-replacement teeth, after orthodontic treatment of the patient with congenitally missing teeth, also provide for fixed orthodontic retention. This is especially pertinent for the young patient (teenager) in whom a conventional FPD or an implant is not yet indicated or practical for the given clinical situation.[10]

e. As space maintainer, for fixed orthodontic retention.[1]

This clinical report describes the aesthetic replacement of a missing mandibular right central incisor and splinting of periodontally compromised teeth adjacent to the prosthetic space with a conservative FRC-FPD resulting in success over a short-term follow up. [20]This treatment option can be categorized as a periodontal prosthesis. Direct technique is conservative, cost effective, eliminates laboratory procedure. The prosthesis can be placed in a single visit using natural teeth, acrylic tooth or composite resin teeth as a pontic. The aesthetics of the FRC-FPD was shown to be considerably better than the aesthetics of FPDs with metal frameworks, as subjectively determined by many observers.[20,21]

It must be emphasized to the patient to avoid heavy biting pressure on the splinted teeth.[22] All eccentric movements should be recorded and relieved. [23]Long-term follow-up is essential to evaluate the fiber reinforced resin splint as an alternative to the conventional partial denture or the fixed prostheses.[21,22,23]

Conclusion:

Fiber-reinforced composites have emerged as promising alternative replacement restoration technique with benefits to the patient as well as for the dentist. It is more comfortable than a removable appliance, nonirritating, and hygienic. Generally, it requires little or no preparation abutment teeth, making this procedure minimally invasive, repairable, and modified. Also, being a reversible technique it permits the review of other restorative options, if need arises, especially when used as a provisional treatment if implant therapy is used at a later date.

CONSENT

All authors declare that ‘written informed consent was obtained from the patient for publication of this case report and accompanying images.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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