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Tooth Replacement Using Natural Tooth Pontic with Fibre Reinforced Composite: A Conservative Approach

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Abstract: *With advances in material science and technology multitude of treatment options are available for traumatically missing anterior tooth. It can be implants, porcelain to metal bridges, Maryland bridges or orthodontic treatment. Development of fibre-reinforced composites (FRCs) has opened a new perspective in such cases. The fibre-reinforced composites have better flexural strength and fracture resistance. FRC bridges even allow replacing natural tooth pontic. This gives the advantage of perfect colour, size and shape of the pontic and additionally psychological satisfaction to the patient. FRC bridges are easy, minimally invasive and reversible procedure, which can be used as single visit procedures. It also lets other options viable for future, if need be. This paper presents a case of traumatic avulsion of mandibular incisor, which was replaced with natural tooth pontic using fibre-reinforced composite. FRC with natural tooth pontic has the advantage of minimally invasive, immediate, single visit, economical and aesthetically appealing method.*

Keywords: *Conservative, Fibre-reinforced composite, Minimal invasive, Natural tooth pontic, Single visit.*

I. Introduction

Loss of anterior tooth may be due to trauma or surgical extraction for periodontal problems. Such loss may have a disastrous impact on patients' psychology. Thus, immediate replacement of lost tooth is essential not only to prevent psychological distress that patients' feel due to loss of facial aesthetics, but also for functional (phonetic) reasons. [1] Various methods to restore a lost anterior tooth range from implants to conventional porcelain fused to metal bridges (PFM). While a PFM bridge is the most invasive treatment, a resin bonded fixed partial denture can be a reasonable alternative in some cases. [2] Still, if available, natural tooth as a pontic gives the benefit not only of being the right shape, size and colour [3] but also psychological advantage for patients of having their natural tooth preserved. Fibre reinforced composites (FRC) have opened a new perspective in dentistry by making composite resin bridges possible and these can be a good alternative to conventional prosthetic techniques.

Fibre-reinforced composites are used in a number of industries ranging from aircrafts, space applications, marine and automotive industry, building construction, furnishing, medical appliances (bone plates, implants and prosthetics etc.), electronics, sports equipment etc. [4] FRCs are distinctive composite material in which plastic matrix is reinforced by various types of thin fibres with high flexural modulus and tensile strength. Variety of fibre types such as glass fibres, kevler fibres, carbon fibres, polyethylene fibres are added in composite materials. These fibre bundles broadly fall in two categories: pre-impregnated with resin and non-impregnated. [3] Glass fibres improve the impact strength and have excellent aesthetic properties. Kevler and carbon fibres have poor aesthetic quality. Polyethylene fibres enhance modulus of elasticity and flexural strength and are almost invisible in resinous matrix. [5] Ultra high molecular weight polyethylene (UHMWPE) fibres have low melting point, high creep and a polyolefin backbone. They exhibit poor wetting properties and are difficult to bond.

In dentistry, the concept of fibre-reinforced materials was first used for acrylic dentures in early 1960s to increase fracture resistance [6] and lately it has been used with composite resins to lessen the problems of low resilience, fracture resistance and toughness. [7] FRC is generally non-cytotoxic and biocompatible. [4] FRC bridges are minimally invasive and economical for restoration of single unit and can be used for replacement of a missing tooth in a single visit. Studies have proved that FRC prostheses have good longevity. [8,9]

everStick C&B is an example of unidirectional oriented E-glass fibres impregnated with PMMA and bis-GMA. Each bundle contains approx. 4000 individual glass fibres. E-glass fibres are cost effective and low density FRCs. These are insensitive to moisture, heat resistant, non-flammable and maintain strength over an extensive range of conditions. [4]

Generally three types of pontics are used with FRC bridges: 1. Natural teeth (surgically extracted or traumatically avulsed), 2. Composite resin, and 3. Acrylic resin teeth. The bonding of prefabricated acrylic resin teeth with composite resin is unpredictable and these may also not have satisfactory size, shape and colour.

Although a composite resin pontic may offer good aesthetic results, but patients' psychological satisfaction results only from using their own natural tooth. [2] If patients' natural tooth is preserved with intact crown; it can be bonded by using fibre-reinforced composites to the adjacent teeth.

This article presents a case of traumatic avulsion of left mandibular central incisor, which was replaced using natural tooth pontic with pre-impregnated glass fibre reinforced composite (everStick C&B).

II. Case Report

A 19 years old male patient visited the Department of Conservative Dentistry and Endodontics, Dr. D. Y. Patil Dental College and Hospital, Pune, India with the chief complaints of missing tooth in lower left front region of the jaw since 1 month and sensitivity with lower left front region of the jaw since 15 days. History revealed that patient met with a road accident one month back. He got multiple lacerations on his face and his lower left anterior tooth became mobile, and other lower left anterior tooth fractured (Fig. 1). He removed his mobile tooth himself and later developed sensitivity with the fractured tooth since 15 days. After one month he visited this hospital for replacement of his lower anterior tooth. Patient brought his avulsed tooth with him which he had preserved in freezer (Fig. 2).

Past dental, medical and personal history were not significant. Patient was given some antibiotics at the time of trauma. Family History revealed that his father is diabetic and is under medication for the same.

Figure 1.

Figure 2.

Figure 3.

General examination revealed no specific problem. On extra-oral examination multiple scar marks on both sides of face were present, no other abnormality was present. Intra oral examination revealed missing tooth 31 with healed socket; Ellis Class II fracture with 32; no mobility, discoloration or tenderness on percussion with 32; erupting 18, 28, 38; deep occlusal caries with 46 and crowding with teeth of upper and lower jaws. Soft tissue examination was normal.Pulp vitality test displayed slight hyper responsiveness with 32. Radiograph of the involved region revealed healed socket with 31 region and oblique fracture with 32 extending to enamel and dentin (Fig. 3). All treatment options for replacement of missing tooth viz. implant, RPD, conventional bridge, acrylic resin tooth, composite resin, Maryland bridge, orthodontic treatment and natural teeth pontic were possible in this case.All the treatment options were discussed with the patient and as patient was highly concerned about aesthetics and was unwilling to go for invasive procedure, following treatment plan was decided: Restoration of Ellis class II fracture with 32, replacement of missing tooth with natural tooth pontic using pre-impregnated fibre reinforced composite (everStick C&B). To treat Ellis Class II fracture etching with 37% phosphoric acid (Prime Dental, India) followed by bonding (3M, ESPE). Composite resin (Filtek Z350 XT, 3M ESPE) was then applied and cured.

Preserved natural tooth was in good condition. The root was separated from crown to get the desired length. Pulp chamber was accessed, pulp extirpated, chamber cleaned and then filled with resin composite. Newly designed natural pontic was tried in to ascertain its position and any occlusal interference before bonding and patient satisfaction with the appearance was ensured. It was stored in normal saline until bonded.Isolation was done using a rubber dam and dental floss was used to predetermine the required length of everStick C&B (GC India Dental Pvt. Ltd.) by measuring the length from 32 to 41 (Fig. 4A). Using floss as templet a piece of everStick C&B was cut to an equal length.

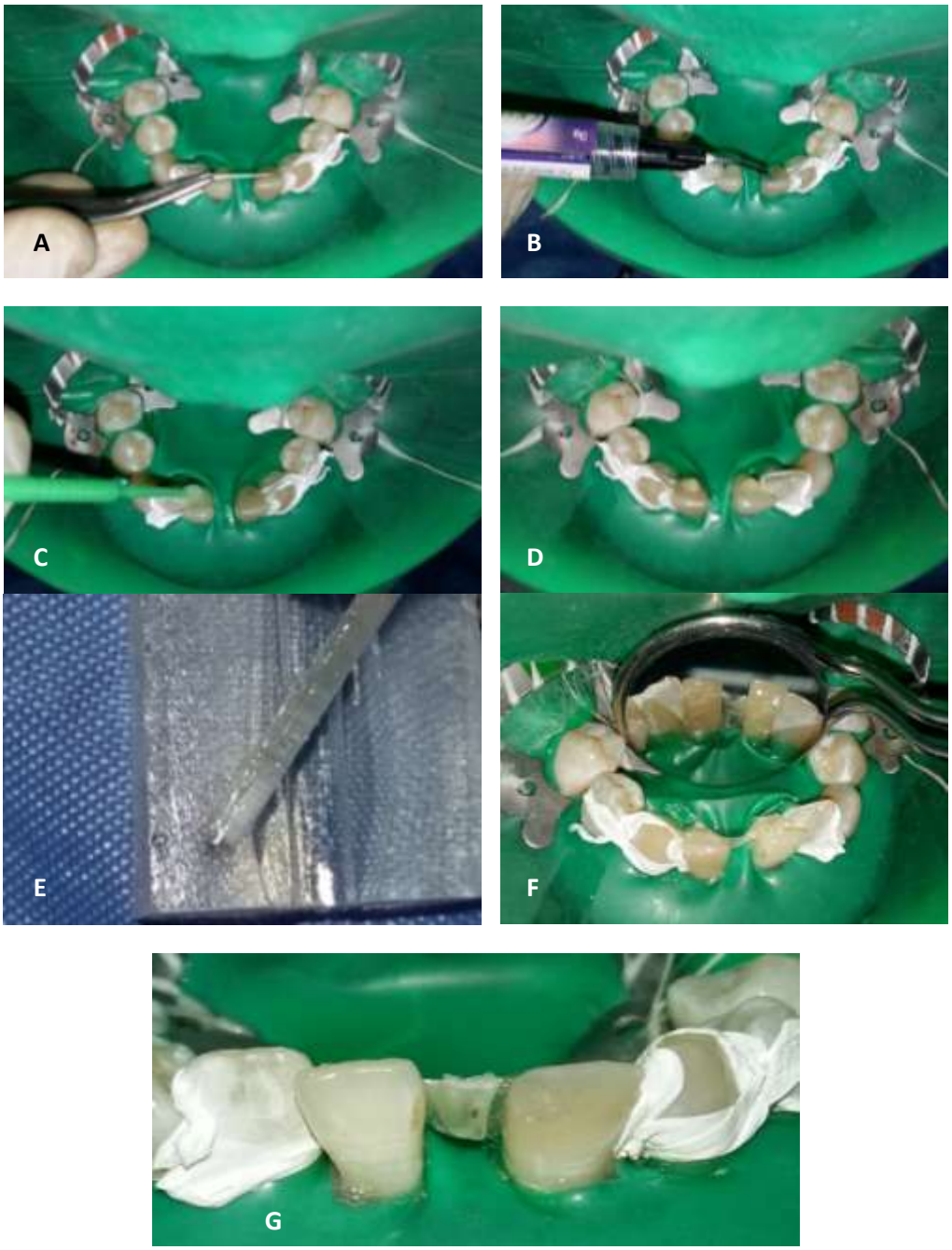

Figure 4.

Adjacent teeth were isolated, cleaned with pumice and dried. Natural pontic was also cleaned and dried. Abutment teeth surfaces were prepared by etching with 37% phosphoric acid (Prime Dental, India), washing and drying. Dentin bonding agent (3M ESPE) was applied and cured. A thin layer of flowable composite (G-aenial Universal Flo, GC, India) was placed over the abutment teeth and pontic but not cured. The pre-cut fibre was placed on abutment teeth; the fibre was spread on the teeth and light cured. A small piece of transversely placed fibre was added onto the fibre reinforced composite bridge to support the pontic (Fig. 4B-G). Natural pontic was bonded to FRC bridge and cured (Fig. 5A-C). Post-operative results were good and patient was satisfied with aesthetic appearance (Fig. 6). Postoperatively patient was instructed to avoid vigorous brushing, hard food and to use uni/end-tufted brushes and water floss (Waterpik, Vertex). Patient was followed up till 1 year after treatment and results were good. Long term follow up studies are required to evaluate long term success of the procedure.

Figure 5.

Pre-operative Post-operative

Figure 6.

III. Discussion

Replacement of a missing anterior tooth is important not only for functional or aesthetic reasons but also to provide psychological support to patients. A variety of pontics can be used to effect such replacement. Pontics can be attached to the adjacent teeth using adhesive composite resins, nylon mesh, wires, cast metal frameworks or metal mesh bonded to the adjacent teeth [10, 11].

Clinical failures have been noted as these materials could not withstand the repeated loading stresses of normal and para-function [1]. Now such replacement can be achieved through the use of fibre reinforced composites. Increased tensile strength, increased flexural strength and fracture resistance of composite materials is achieved through fibre reinforcement. The reinforcing fibres get chemically bonded to the polymer matrix with covalent bonds (Rudo et al. 1999) and thus prevent crack propagation [12]. Goldberg et al. 1998 reported that some of the commercially available FRCs had strengths and flexural moduli up to seven times of composite resins having particulate fillers [13].

Classical characteristics of FRCs are high fatigue strength and fatigue damage tolerance, high modulus-weight ratio, high strength-weight ratio and anisotropic properties (Soares et al. 1999) [4]. Depending on the architecture of fibre arrangement in FRC, these can be of various types: Unidirectional or Bi/ Multidirectional (Braided/ Woven). Currently, two types of fibre bundles are manufactured: Pre-impregnated with resin and non-impregnated. In pre-impregnated fibre-reinforced composite, fibre bundles are prewetted with a low viscosity resin in the laboratory under controlled manufacturing conditions. The fibres used in these materials are continuous, long and have higher flexural properties due to their high fibre content [3]. Composite materials are made anisotropic by adding filler materials (fibres) with a certain orientation. This provides high strength and stiffness in one direction of loading. Various types of fibres used are [1,4]:

- Glass fibres (everStick, Splint-It, GlasSpan)
- Quartz
- Ceramic
- Polyester
- Aramid fibres (Kevlar, Twaron)
- Carbon or Graphite fibers (SIGRASIC)
- Polyethylene/ UHMWPE (ultrahigh molecular weight polyethylene) (Ribbond)

The most popular fibre types are Ultra High Molecular Weight Polyethylene (UHMWPE) and glass. UHMWPE is a linear homo polymer of ethylene. It leads to high wear resistance, very low friction coefficient and high impact strength [1]. They are treated with plasma to be chemically integrated with dental resins. UHMWPE is normally intertwined in the form of a fabric ribbon (Ribbond®). Glass fibers, on the other hand, are used in the form of woven short or long loose fibres and fibre bundles. In dentistry, fibres are commonly used in the form of woven glass-ribbon fabric and unidirectionally oriented short fibres. E-glass and S-glass

fibres are commonly used glass fibres in FRCs. E-glass fibre consist of: 54.5% SiO_2, 14.5% Al_2O_3, 17.5% CaO, 4.5% MgO, 8.5% B_2O_3 and 0.5% Na_2O by weight. Whereas, S-glass fibre consists of 64% SiO_2, 26% Al_2O_3 and 10% MgO by weight. [4] everStick C&B® is an example of unidirectional oriented E glass fibres impregnated with PMMA and bis-GMA.

Advantages of E-Glass fibres are: a) low cost and high production rates; b) low density; c) ability to maintain strength over a range of conditions; d) moisture resistance; e) chemical-resistance; and f) heat-resistance. E-Glass Fibres (everStick C&B) are indicated in cases requiring immediate bridges after extractions, to preserve natural healthy tooth tissue, in trauma cases, to replace congenitally missing teeth in young patients, before or during implant treatment, for provisional bridges and when patient wants an economical and aesthetic solution. [4]

IV. Clinical Relevance

The technique offered in this article is simple, minimally invasive and aesthetic way of replacing a traumatically avulsed tooth with natural pontic in a single visit. This technique also promises an inexpensive treatment for those who cannot afford conventional tooth replacement and/or want to preserve their natural tooth.

V. Conclusion

Fiber-reinforced composites are a promising alternative for those patients who want safe, affordable, biocompatible, and cosmetically appealing restorations. The abutment teeth require little or no preparation, making this procedure minimally invasive and reversible. Being a reversible technique it permits the review of other restorative options, if need arises. The procedure is time saving as it is completed at the chairside in a single visit and a cost-effective technique as it avoids laboratory costs. It can also be used as a provisional treatment or as a permanent prosthesis. An advantage of FRC compared to metal resin-bonded FPDs is the tooth-colored property.

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