Case Report

International Journal of Dental and Health Sciences
Volume 01, Issue 04

AESTHETIC REPLACEMENT OF CONGENITALLY MISSING TOOTH USING FIBER-REINFORCED COMPOSITE (FRC)

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ABSTRACT:

Tooth agenesis is defined as congenital absence of one or more teeth in primary or permanent dentition and is a common oral variation that affects a large population group. Among the missing one's, maxillary lateral incisor is more frequent causing esthetic and functional impairments in the affected individual. It might be associated with systemic problems, syndromic conditions or other oral anomalies. Management of missing lateral incisors involves a multi-disciplinary approach for rehabilitation of impaired esthetics and function. Fiber-reinforced composite (FRC) resins offer a conservative, fast, and cost-effective alternative for single and multiple teeth replacement and may prove to be a successful modality for aesthetic and functional replacement of congenitally missing teeth, which has always been a challenge for the dentist. The aim of the case report is to describe the clinical procedure in rehabilitation of edentulous space through fabrication of direct fiber-reinforced composite resin fixed partial denture with periodontal splinting of adjacent teeth.

Key words: Interdisciplinary Treatment, Missing tooth, Replacement, Fiber – reinforced composite

INTRODUCTION:

Permanent lateral incisors are the third most common missing tooth in the mouth after upper and lower second premolars [1]. It is more common bilaterally and has a slightly higher female predilection. The prevalence of congenitally missing lateral incisors is between 1 and 2 percent [1,2]. Congenitally missing maxillary permanent lateral incisors often lead to an unattractive appearance and difficulty in treatment planning. Many factors must be considered before a decision is made both to close spaces and modify the canines, or to redistribute the spaces and replace the missing teeth with prosthesis. Good communication among patients, dental specialists, and general practitioners is necessary [1].

When a maxillary lateral incisor is missing, often the treatment options can be clearly

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defined, that is, substitute an adjacent tooth for the missing one; open the space for an implant, a bonded bridge or fixed bridge. Three treatment options exist for the replacement of congenitally missing lateral incisors. They include canine substitution, a tooth-supported restoration, and a single-tooth implant. Selecting the appropriate treatment option depends on the malocclusion, anterior relationship, specific space requirements, and condition of the adjacent teeth. The ideal treatment is the most conservative option that satisfies individual esthetics and functional requirements. Today, the single-tooth implant has become one of the most common treatment alternatives for the replacement of missing teeth [2,3].

This case describes an interdisciplinary diagnostic approach to conservatively manage the anatomic and esthetic challenges of congenitally missing teeth using space management techniques that resulted in a successful esthetic outcome.

The use of nonmetallic, fiber-reinforced, resin-based composite dentistry for human tooth replacement is detailed for anterior and posterior indirect procedures. The use of fiber reinforcing increases the flexural strength of present day materials. The techniques covered in this paper are direct, chairside, single sitting techniques for placing fiber-reinforced bridges. The most practical situations for these devices are the adolescent with congenitally missing lateral incisors, the geriatric problem, or any number of similar situations that demand a more conservative and less invasive approach than that required by most laboratory-created prostheses. [4,5,6,7]

Fiber-reinforced composite (FRC) technology is well proven in industrial applications. In dentistry, it dates back to the 1960s, and was first proposed for reinforcing denture base acrylic.[1,12] Today, FRC is most commonly used in prefabricated form for endodontic posts. There are also a number of laboratory processed systems available for bridge fabrication. Unfortunately, these systems offer few advantages over PFM technology. In terms of cost to the patient there is no advantage. [4,8,9]

FRC bridge,For about half the cost of a PFM bridge, the dentist can fabricate a replacement for a missing tooth directly in the mouth in less than 2 hours. A number of variations on the technique have been published in the literature in the last 20 years,[22-29,30] and no less than five manufacturers make the materials available. Still, the technique has failed to gain widespread acceptance. Perhaps it just seems a little too good to be true. The authors have placed or participated in the placement of hundreds of these bridges over the years, and have found the longevity to be comparable with other direct composite restorations. They are certainly more conservative and cost-effective than PFM bridges. [4,9,10]

Case selection for FRC bridges is important, as it is for all treatment procedures. The authors have seen the technique used to replace virtually every tooth in the mouth at one time or another. The technique is most predicable when used to replace missing incisors. The limitations on fiber orientation created by fabrication of the bridge directly in the mouth limit the ability of the prosthesis to resist torsional forces. The ideal indication for a direct FRC bridge restoration is probably a single missing lower incisor, a situation for which a PFM bridge with full-coverage retainers often produces less than satisfactory results. [4, 5, 11, 12]

CASE DETAIL:

Phase 1: Therapy planning **(Figs 1a to 1h)**

To produce a gapless, aesthetically appealing maxillary arch were two alternatives:

I- Orthodontic space closure: positioning of the canines in place of the lateral incisors. This approach would have required a balancing extraction of two premolars in the lower jaw.

II- space opening for the prosthetic replacement of 12 .

The first treatment alternative would have led to a deterioration of the facial appearance. As a result of balancing extraction of 34 and 44 and mainly from the mesial conducted space closing it would have come to a flattening of the profile. The patients were advantages and disadvantages of the two alternatives discussed. The parents opted for the non extraction therapy and prosthetic treatment. Note: Regardless of the type of prosthetic replacement was necessary to create sufficient space in the dental arch. This aspect will be not only in the crown area but also interradicularly because of a possible -implantation-considered.

All dental professionals involved in the treatment (orthodontist, periodontist, and operative Dentist,or general dentist) evaluated the clinical case individually to decide which noninvasive procedures were indicated. Next, the four professionals discussed the prognosis and limitations of the case. The operative dentist performed a diagnostic wax-up to provide a model of the multidisciplinary treatment **(Figs 1a to 1h)**. After patient approval, the conservative treatment was then split into two restorative phases: **orthodontic,and restorative.**

Phase 2: Orthodontics (Figs2a to 4c)

The orthodontic phase began with the analysis of craniofacial growth, radiographs, and study casts. Primary maxillary canines were extracted, and a fixed orthodontic appliance was used to close the diastema between the maxillary central incisors and redistribute the interdental spaces for esthetic rehabilitation **(Figs 2a-c)**. The orthodontic treatment used the following parameters for evaluation: sagittal relationship between the dental arches; posterior occlusion; location, shape, and size of the canines; amount of remaining interdental space; and profile and facial skeletal pattern of the patient. After orthodontic treatment was finalized, the orthodontic brackets were removed and a removable appliance was used to replace the missing maxillary lateral incisors **(Fig 3a –c, Fig 4a-h)**.

Phase 3; operative (Figs 5a to f)

This section presents the steps for the placement of an anterior direct FRC bridge, created at the chair in the patient's mouth. The authors and many other practicing dentists who have learned the technique and are placing these bridges in hundreds of patients worldwide can assure their patients that the technique has been used successfully for at least 20 years. The first bridges from 1982, many in the mouths of professional ice hockey players, are still in function.

The authors' staff schedules 1 hour for replacing one anterior tooth, and 2 hours for replacing two anterior teeth. The fee is the same as that charged for Maryland bridges.

During the treatment planning stage, determine the area of opposing tooth contact so that the proper positioning of the intra-enamel preparations can be made later and the occlusion will not interfere with the placement of the reinforcing fiber band. This can best be accomplished by sitting the patient upright and using red marking paper, having the patient close in all functional excursions. In this case, the missing lateral incisor was replaced with a FRC bridge by attaching a fiber band into very shallow preparations placed into the lingual enamel of the central and the canine. Do not make any preparations until the initial step in creating the pontic has been accomplished **(Figs 5a-h)**.

Creating the Pontic Button: Using powder-free or cleaned fingertips that have been moistened with bond resin , roll a small ball of a microfill resin composite composite and press it onto the air-dried gingival tissue. The bond resin prevents the composite from sticking to the gloved fingers after the application of the composite onto the dried gingival tissue. The choice of a microfill ensures that the tissue-contacting surface of the pontic can be highly polished. By holding the ball in a position that will spread the ridge-lap portion onto the tissue so that the incisal portion becomes a sharp line, the tissue portion will spread from labial to lingual onto the ridge-lap area. Keep the index finger of the placing hand on the lingual portion of the pontic button as the initial shaping with a suitable instrument begins. Shape the interproximal surfaces as you would like to see in the finished product. Do not allow the soft composite to fill the undercut embrasures of the adjacent teeth. Create an opening just large enough so that a floss threader and floss can be passed through after the bridge is completed.

Press the jaws of a cotton plier into the labial and lingual surfaces of the unpolymerized pontic button **(Figs 5e)**. These indentations will indicate labial and lingual later and give more support to the gripping jaws of the cotton plier after the composite is cured. There will be a grinding and shaping step to finalize the fit of the pontic button into the space later, and these grooves will facilitate safe holding. Polymerize the pontic button thoroughly and remove it from the mouth. Begin the shaping and polishing of the pontic button. The goal is to polish all of those surfaces that will be inaccessible once the pontic is incorporated into the structure. These include the tissue contacting the ridge, the interproximal surfaces, and the transition from the ridge-lap onto the labial and the lingual surfaces. Remove a portion of the labial, interproximal, and lingual areas of the pontic button after polishing, creating a finishing line. This finishing line will enable the placement of the balance of the labial, lingual, and interproximal composite of the pontic structure, eliminating the requirement of shaping and polishing close to the tissues and the abutment teeth after the pontic is cured in place. After these steps, trial place the pontic button for a final fit to be sure that the height of contour of the pontic button will match the gingival height of the central and the canine. Set the pontic button aside in a safe place.

Tooth Preparation: Prepare lingual intra-enamel preparations in those areas of no occlusal contact, if possible. When this is not possible, a deeper preparation must be made. With today's excellent dentin adhesives, this is not a major concern. The dimensions of the preparations should be 1 mm greater inciso-gingivally than the width of the fiber band chosen. Always choose the widest band that can be safely used. The determining factors will be the opposing contacts and the length of the abutment teeth. Most post-orthodontic cases have excellent lingual clearance. It has been the authors' experience that 2-mm bands are the norm. The preparations should cover two thirds of the MD dimension of the lingual aspect of the abutment teeth.

Fiber System Planning (Figs 5a-f, to 6a-h)

Using a piece of waxed dental floss or dental tape, cut a trial pattern so that it can be fitted into the preparations prior to cutting the actual fiber band (ever stick,Stick Tech Ltd) (Figure5a). This band should fit loosely into the preparations to prevent the possibility of fibers not fitting completely into the preparations during the bonding step. After cutting the fibers to the proper length, try them into the preparations. When satisfied that the band will fall into place where intended, saturate the fibers with a filled light-curable resin, following the instructions for the specific fiber system that is to be used.

Prepare the preparations for attaching the fiber band by cleaning thoroughly with 5.25% sodium hypochlorite (Clorox), etch as usual, and seal with a dentin/enamel adhesive. Polymerize as per manufacturer's instructions.

An efficient method of placing the fiber band into the preparations utilizes a piece of flat matrix material cut to match the gingival contour of the lingual aspect of the central incisor, and another to match the lingual of the canine. These matrices do not need to be the exact shape of the gingival contours, merely rounded to prevent a squared corner of the matrix from resisting being positioned correctly as the fiber band is cured into the abutment preparation. A small volume (too little is better than too much) of a heavy viscosity microhybrid is injected onto the matrix strip as a patty, positioned so that when mated into the lingual aspect of one of the abutment teeth, the composite will press into the preparation area. One end of the saturated fiber band is pressed into this patty. The matrix is then carried to the mouth with a cotton plier and pressed into the acid-etched, dentin adhesive sealed preparation. The low-viscosity filled resin that is used to saturate the fiber band is forced into the preparation by the heavy viscosity patty on the matrix. This is held with a finger, and the curing energy is transmitted through the labial aspect to cure the fiber band into one preparation . The other end of the band is treated in the same manner to attach it to the other abutment .

he band is positioned so there will be sufficient space between the ridge and the fiber band, so the pontic button can be slipped between the band and the tissue. If this is not sufficient, while holding the matrix with the index finger, pull the band toward the incisal with an explorer, then polymerize the first abutment. Aim the light guide so that the energy is directed away from the pontic area of the fiber band if at all possible. This will result in that portion of the pontic area remaining uncured, making placement of the pontic button more efficient. Be aware of the labio-lingual position of the band, as it should be more labially positioned than lingually . If it is more to the labial, there is no possibility of exposing fibers while adjusting the occlusion.

Try the pontic button in the space. Usually some reduction of the pontic button will be necessary to enable the polished ridge-lap portion to be positioned in the optimum position for aesthetic results. Once this has been accomplished, clean all surfaces of the pontic button with 5.25% sodium hypochlorite (Clorox), rinse, dry, and apply the same dentin/enamel adhesive used in the preparation to create an adhesive surface on the pontic button.

Holding the pontic button in the proper position with a light ridge-lap pressure, inject a flowable composite resin between the fiber band and the closest surfaces of the pontic button, and polymerize the flowable so that the pontic button is now held firmly in place **(Fig. 5d-f)**. Inject a microhybrid (Tetric Ceram, Ivoclar Vivadent) onto the lingual aspect of the pontic button, and shape with suitable instruments. Polymerize lightly, ie, cure enough so that the composite can no longer be moved, then inject onto the labial surface with a microfill, shape, and now cure both labial and lingual thoroughly.

Final Finish: Final shaping and trimming is accomplished with spiral bladed finishing burs, number H48L-010 (labial) and H379-0243 (lingual) from Axis or Brasseler. **(Figs 6a to h)**. These are used dry with light pressure, using the highest speed the slow-speed handpiece will deliver.

DISCUSSION:

This case report is an example of the type of clinical situation, the clinicians can encounter in their practice. In such situations, a total management plan should include dental and oral assessment, evaluation of the patient's complaints, needs, and socioeconomic status.

This treatment modality represents a conservative, esthetically pleasing and rapid solution of a missing tooth when implant placement and/or fixed treatment are not feasible because of financial, social or time restrictions.[13] This type of conservative treatment allows practitioners to evaluate the clinical condition over time, while offering the patient acceptable restorations. The predictability and longevity of this prosthetic design is less than conventional fixed bridges, but they are less expensive and have low biological cost. [15] Moreover, they offer good esthetics, easy cleaning, less biological damage and no chance of having an undetected debonded retainer with decay underneath it. [13]

This clinical report describes the aesthetic replacement of a missing mandibular left lateral 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. This treatment option can be categorized as a periodontal prosthesis [14]. 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 [14,15].

The development of dentin adhesive systems has also led to similar and minimally invasive preparations. But clinical longevity of these prosthesis was found to be poor due to lack of interaction between metals and composite resins, leading to detachment under occlusal forces [5,6]. In vitro studies have shown that FCR materials exhibit increased strength when compared to particulate resin alone and can withstand occlusal forces in load bearing situations. Vallittu and Sevelius studied clinical success of FRCPs and found 93% survival rate after 24 months follow up. In another study Vallittu et al,8 showed success rate was to increase from 75% to 95% at 42 months [16].

Metal framework adhesive fixed prostheses in comparison were found to have 61% survival rate in long term follow up to 11 years. Corrente & Hoppner et al et al studied resin-bonded fixed partial dentures and splints in periodontally compromised patients and the 20 year cumulative survival rate from life table analysis was 76.2% (70.6% for fixed partial denture and 80.7% for splints). [17,18,19]

CONCLUSION:

More time-efficient and cost-effective dental procedures must be developed and clinically proven for the contemporary dentist to serve today's educated patient. The use of fiber-reinforced resin systems are found in many devices that we use daily. Industry can implement more expanded uses of this technology without the concerns of human response to the chemistry of the resins which they incorporate. Clinical observations, evidence-based designs, and proven restorative methods have been combined to allow the dentist to use this methodology to restore missing teeth in selected situations. The limited history of dental devices created through the use of fibers and resin has been mostly anecdotal, but with the advent of advanced dental resin-based composites, user-friendly fiber systems, and ever increasing literature support, direct FRC bridges are entering the realm of routine treatment. All that is now required is for contemporary dentists to avail themselves of the opportunities presented by these techniques.

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FIGURES:

Fig. 1a-e: Intraoral views in centric relation: Class I occlusion on the right and left side, deep bite, missing of the lateral incisor 12 with persistence of 53. 13 is erupted at the position of 12.
Fig. 1f-g: Lateral and frontal facial photograph picture
Fig. 1h: Orthopantomogram (OPG) at the beginning of treatment

Fig 2a-c: Intraoral view after directly after the bonding of the Brackets.

Fig 3a-c: Intraoral view after the distalization of 13 and harmonious space management

Fig. 4a-h: Intraoral views after orthodontic treatment and debonding

Fig. 5a-f: Intraoral views showing the steps for the reconstruction of a tooth 12

Fig. 6a-g: Intraoral views afterat the End of treatment **Fig. 6h:**Orthopantomogram (OPG) at the end of treatment