Pediatric Restorative Option for Congenitally Missing Anterior Teeth: A Carolina Bridge Case Series

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Received Date: 03-03-2022; **Accepted Date:** 24-03-2022; **Published Date:** 31-03-2022

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Abstract

Congenital absence of permanent maxillary lateral incisors can have a negative impact on adolescent patients from a functional and psychological standpoint. Historically used treatment options for hypodontia are invasive, warranting preparation of the abutment teeth and/or comprehensive orthodontic treatment. Dental implants are a preferred modality without the need for abutment preparation; however, are contraindicated until the completion of skeletal growth. This case-series presents two case-reports of adolescent patients with congenitally missing permanent maxillary lateral incisors restored using a novel resin-bonded bridge (Carolina Bridge). The Carolina Bridge is a conservative, esthetic, cost-effective, reversible, long-term, interim treatment option to replace missing teeth until implant-supported restorations are indicated. The basics of the Carolina Bridge including indications, contraindications, case selection criteria and clinical fabrication steps are presented in detail to help clinicians with treatment planning and execution.

Keywords

Hypodontia, Carolina Bridge; Esthetic Restoration; Resin-Supported Bridge; Congenitally Missing Teeth

Introduction

Congenital absence of teeth can be a significant restorative challenge in adolescent patients, particularly when involving the anterior sextant. The permanent maxillary lateral incisors are the most commonly missing anterior teeth, with a prevalence of 2.2% [1]. Congenital absence of teeth affects form, function and esthetics during adolescence, when patients become aware of self-image and esthetic social constructs [1,2]. These patients can experience bullying and subsequent psychological distress, depression, anxiety and underachievement [2]. Dental-specific implications such as tipping and supra-eruption of adjacent teeth also pose challenges to future restorative management due to increased loading, wear and periodontal consequences [3]. While generating a restorative treatment plan, multiple factors need to be considered including the size, shape, position and integrity of adjacent teeth along with alveolar and craniofacial bone growth.

Various restorative treatment options for hypodontia have been previously published and advantages and disadvantages of each are presented in Table 1 [4]. A majority of these options are considered invasive, involving preparation of adjacent teeth. Dental implants do not require abutment tooth preparation and thus have been favored as a conservative treatment option. Although dental implants are conservative, esthetic and functional, implant placement is contraindicated in adolescent patients with incomplete skeletal growth [5-7]. Implants placed before the completion of craniofacial growth can lead to future infra-occlusion and labial position of the implant [8]. Hence, implant placement should be deferred until or even after the completion of skeletal growth (females: 18-19 years, males: 20-21 years) [7].

In contrast with the existing treatment modalities, resin-bonded bridges, such as the Carolina Bridge (CB) provide a conservative, esthetic, cost-effective, reversible and long-term interim restorative option. This is especially beneficial when implants are planned after the completion of growth. CBs are ridge-lap design porcelain-pontics bonded to adjacent teeth using composite resin, with virtually no abutment teeth preparation. This paper provides two case-reports of adolescent patients with hypodontia in the maxillary anterior sextant with long-term (two-year) follow-up.

Treatment	Advantages	Disadvantages
Removable Partial Denture	<ul style="list-style-type: none"> -Conservative option -Can replace multiple missing teeth and soft tissue defects -Can act as a transitional prosthesis 	<ul style="list-style-type: none"> -Limited use in children and adolescents due to continued jaw growth -Increased plaque retention -Poor compliance
Conventional Fixed Partial Denture	<ul style="list-style-type: none"> -Esthetic option -Good option when abutments have enamel defects or require restorations or endodontic treatment -Does not require bone or tissue support 	<ul style="list-style-type: none"> -Potential loss of tooth vitality -Irreversible, invasive treatment -Subgingival margins can lead to periodontal complications -Active and passive eruption may expose restoration margins
Canine Substitution	<ul style="list-style-type: none"> -Relatively esthetic option -Great in cases of maxillary prognathism or increased overjet -No adverse impact on temporomandibular joint -Early intervention possible 	<ul style="list-style-type: none"> -Strict initial occlusal relationship criterion -Canines differ in color, morphology and emergence profile from other incisors -Extensive orthodontic treatment needs -Group function occlusion after treatment
Resin-Bonded Metal-Framework Bridges	<ul style="list-style-type: none"> -Relatively conservative option requiring minimal abutment tooth preparation -Ease of repair and adjustment -Relatively inexpensive 	<ul style="list-style-type: none"> -Requires bondable enamel substrate -Metal wings compromise esthetics -Frequent bond-failure with differential tooth movement -Not indicated in presence of parafunctional habits
Dental Implants	<ul style="list-style-type: none"> -Conservative option -Highly esthetic option -Functional and predictable outcomes 	<ul style="list-style-type: none"> -Contraindicated until completion of skeletal growth -Requires adequate bone and soft tissue
Resin-Bonded Bridge	<ul style="list-style-type: none"> -Most conservative option -Re-intervention is possible -Decreased fabrication time and costs -Ease of repair and adjustment -Highly esthetic option 	<ul style="list-style-type: none"> -Increased swallowing/aspiration risk -For use in short edentulous spaces only -Requires bondable enamel substrate -Not indicated in presence of parafunctional habits -Requires optimum overjet and overbite

Table 1: Existing treatment modalities for hypodontia with advantages and disadvantages of each modality.

Case Report

The details of each case are presented in Table 2. In both cases, the patient and legal guardian were presented with various restorative treatment options including associated risks and benefits. Due to incomplete skeletal growth, implant placement was recommended as a future restorative option. The patients and families in both cases declined other options and opted for replacement of their missing tooth/teeth with a resin-supported CB as a long-term interim restoration until the completion of skeletal growth. Informed consent was obtained followed by preparation-fabrication of CBs. After CB placement, each case was followed at 1, 3, 6, 12 and 24 months. The parents provided permission for use of de-identified intra-oral. Indications, contraindications, case selection criteria and clinical steps for the CB are presented in Table 3.

Case 1	An 11-year-old healthy Caucasian male presented for orthodontic treatment. Upon a clinical and radiographic examination, he was diagnosed with congenitally missing teeth FDI #s 12 and 22. After radiographic and clinical records were obtained, a treatment plan was generated establishing ideal class I relationship and open spaces for #12 and #22. After completion of orthodontic treatment in 2015 at age 16, the patient was referred for restorative treatment. The patient and family provided informed consent for fabrication of the Carolina Bridge, with future plans of implant placement after completed skeletal growth. The patient had dental fluorosis and hence, nightguard vital bleaching was undertaken for three weeks initially. The remaining dark and white discolorations were conservatively removed using a round diamond bur and copious water spray. The teeth were then restored with composite resin under rubber dam isolation. Finishing and polishing was carried out, creating age-appropriate form, texture and polish. Carolina Bridges were then fabricated and bonded to the adjacent teeth
Case 2	A 14-year-old healthy Caucasian male presented for restorative treatment for congenitally missing FDI #12. Space between FDI #13 and #11 was regained orthodontically six months before fabrication of the Carolina Bridge.

Table 2: Detailed description of the two Carolina Bridge cases.

Advantages	Reversible, esthetic, cost-effective, conservative (no abutment tooth preparation), easy to repair, and able to act as a long-term interim prosthesis
Disadvantages	Need for excellent laboratory/bonding protocol, staining of composite resin connectors (if not finished and polished), possible risk of aspiration in cases of bond-failure (unilateral failure more common, protecting against aspiration), requires sufficient (~5 mm inciso-gingival) interproximal bondable enamel substrate, and potential for failure in patients with parafunctional habits
Ideal Conditions	Optimal overjet and overbite (1-2 mm), >5 mm inciso-gingival sound enamel on proximal surfaces of periodontally stable abutment teeth, and single-tooth edentulous span
Indications	Long-term interim prosthesis for missing incisors in young patients (implant treatment planned after completion of skeletal growth) or permanent prosthesis when other treatments are neither practical nor affordable
Contraindications	Short abutment teeth, deep bite, severe enamel defects, proximal restorations or caries in abutment teeth, large diastemas, evidence of parafunction, or periodontally compromised abutment teeth
Detailed Clinical Steps Involved in Fabrication of the Carolina Bridge	
1st Appointment (Duration: 45-60 minutes)	<ul style="list-style-type: none"> -Evaluation of case selection criteria and consultation with periodontists, orthodontists, and endodontists (if required) and informed consent -Shade selection prior to dehydration of teeth -Clinical photographs with/without shade guide in normal day light and black background along with black-and-white photographs -Clinical photographs to show arch form and emergence profile -Elastomeric impression of both arches and bite registration -Laboratory prescription for a Feldspathic porcelain pontic with ridge-lap design
Laboratory steps	<ul style="list-style-type: none"> -Laboratory fabrication of Feldspathic porcelain pontic (variable lab price range \$400-\$800) with ridge-lap design and creation of putty index (lingual matrix) -Etching of the entire proximal surfaces (between facial and lingual line angles) of the pontic with hydrofluoric acid*
2nd Appointment (Duration: 45-60 minutes)	<ul style="list-style-type: none"> -Isolation of arch segment with rubber dam and pharyngeal curtain for safety -Try-in to evaluate proximal/incisal fit, arch form, emergence profile and esthetics -Cleaning of the pontic with phosphoric acid to remove glassy residue -Silanating the etched proximal surfaces (between facial and lingual line angles)* -Adhesive application on pontic, air-thinning and light-curing* -Cleansing of abutment teeth with pumice

	<ul style="list-style-type: none"> -Roughening of abutment teeth using a diamond bur at low speed to remove the outermost fluoride-rich layer (impervious to etching) -Etching of the entire proximal surfaces (past facial and lingual line angles) of abutment teeth* -Pre-warmed hybrid composite (with higher filler content) application to the pontic -Placement of pontic with the aid of a putty index (lingual matrix, supplied by the laboratory) -Shaping of the connectors and defining the facial embrasures for esthetics. Bulking-up lingual embrasures (without occlusal interference) for strength and retention -Creation of adequate gingival embrasure contours for hygiene -Addition of composite in any deficient areas, if needed -Light-curing from both lingual and buccal aspects* -Finishing and polishing to define final shape and occlusal adjustment for minimal centric and functional contacts
*According to the manufacturer's instructions	

Table 3: Basics of the Carolina Bridge, indications, contraindications, case selection criteria and clinical steps involved in fabrication.

Discussion

Case selection criteria and clinical steps for restoring teeth with CBs were discussed by Heymann in 2006 [9]. The pontic is fabricated with Feldspathic porcelain, providing advantages of esthetics, color stability, strength and the ability to etch the proximal surfaces for retention. CB use in adolescent patients is especially indicated since it requires virtually no abutment preparation; deeming it reversible and reducing the risk of dental pulp exposure in immature teeth. Additionally, CBs are associated with less periodontal complications due to the ridge-lap pontic design and margin placement [10].

Retention in CBs is entirely dependent on the proximal resin connectors, necessitating appropriate case selection [9]. Optimal occlusion, periodontal health and adequate interproximal surface bonding are imperative for success of the restoration. The most favorable occlusion demonstrates optimum (2 mm) overjet and overbite [9]. Interproximal abutment height of >5 mm inciso-gingivally in sound enamel is desirable for adequate bonding [9]. Patients with previously restored abutments, severe enamel defects, deep bite and/or evidence of bruxism or parafunction are not ideal candidates for CBs (Table 3). Missing canines or posterior teeth are also contraindications for CB treatment [5,9]. All anterior teeth need to be fully erupted prior to fabrication.

Inappropriate case selection can lead to bond-failure due to differential tooth movement and low flexural strength of the ceramic [5]. The cantilever design (bonding on one proximal side of the pontic) has demonstrated higher retentive success when compared to allowance of fixed-fixed designs (bonding on both proximal sides of the pontic) [11]. This is attributed to differential tooth movement with unilateral bonding [6,10]. However, bond-failure in a cantilever design leads to immediate prosthesis failure, revealing the edentulous area, compromising esthetics and posing a risk of swallowing or aspiration of the pontic [6]. Bond-failure of one proximal area in a fixed-fixed design could be attributed to the differential tooth movement. Additionally, such bond-failure could be seen in the immediate post-operative period [6]. However, bond-failure of one proximal area in fixed-fixed design could be esthetically inconsequential and reduce aspiration risk, but potentially predisposes the patient to secondary caries [6]. Fortunately, even in cases of bond-failures, the abutment teeth are not compromised and repair is easily achievable using a similar adhesive protocol as shown in Table 3 [9,10]. In both our cases, CBs were fabricated with fixed-fixed design. In our second case, bond failure was noted between pontic and canine in the one month post-operative period. The debonded area was repaired and no bond failure was noted thereafter, throughout the two year follow-up period.

There are no Randomized Clinical Control Trials (RCTs) demonstrating the relative success rates of all plausible restorative options for treatment of hypodontia in the anterior sextant. Until a time when RCTs can provide enough evidence, longevity can only be considered anecdotally, as presented in this case-series (Fig. 1-4). Absolute adherence to case selection criteria is integral in increasing the chances of CB success. Furthermore, it is critical to provide anticipatory guidance to the patients and families regarding dietary instructions such as avoiding chewing hard candies with incisors and recommending use of mouthguard during contact sports. It is pertinent to provide anticipatory guidance regarding bond failure in the immediate post-operative period and prompt reporting to the dentist for repair of the CB to avoid secondary caries, space loss, complete debonding, or aspiration.

Figure 1: Pre-operative right lateral (A), centric (B), and left lateral (C) photographs from Case #1 demonstrating congenitally missing FDI #12 and #22. Maxillary incisors after bleaching (D), micro-abrasion (E) and restoration with direct partial resin composite veneer (F).

Figure 2: Intra-operative photographs from Case #1 demonstrating shade selection with natural light (A), black-and-white (B) and dental lamp (C). Clinical photographs of Feldspathic porcelain pontics after fabrication from facial (D and E) and lingual (F) aspects.

Figure 3: Case #1 photographs showing rubber dam isolation of maxillary anterior sextant and try-in of pontics with putty index (lingual matrix) (A). Immediate post-operative photograph after cementation of pontics (B). Pre- (C) and post-operative (D) photographs after 6 months.

Figure 4: Pre- and post-operative photographs in Case #2 showing the Carolina Bridge for replacement of missing FDI #12.

Conclusion

The CB provides an esthetic, conservative, reversible, cost-effective and long-term interim restorative option. The CB is ideal for adolescent patients with congenitally missing anterior teeth and incomplete skeletal growth, while awaiting future implant-supported restorations.

Conflict of Interest

There are no conflicts of interest.

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Puranik CP | Volume 3; Issue 1 (2022) | JDHOR-3(1)-044 | Case Report

Citation: Puranik CP, et al. Pediatric Restorative Option for Congenitally Missing Anterior Teeth: A Carolina Bridge Case Series. *J Dental Health Oral Res*. 2022;3(1):1-10.

DOI: <http://dx.doi.org/10.46889/JDHOR.2022.3107>